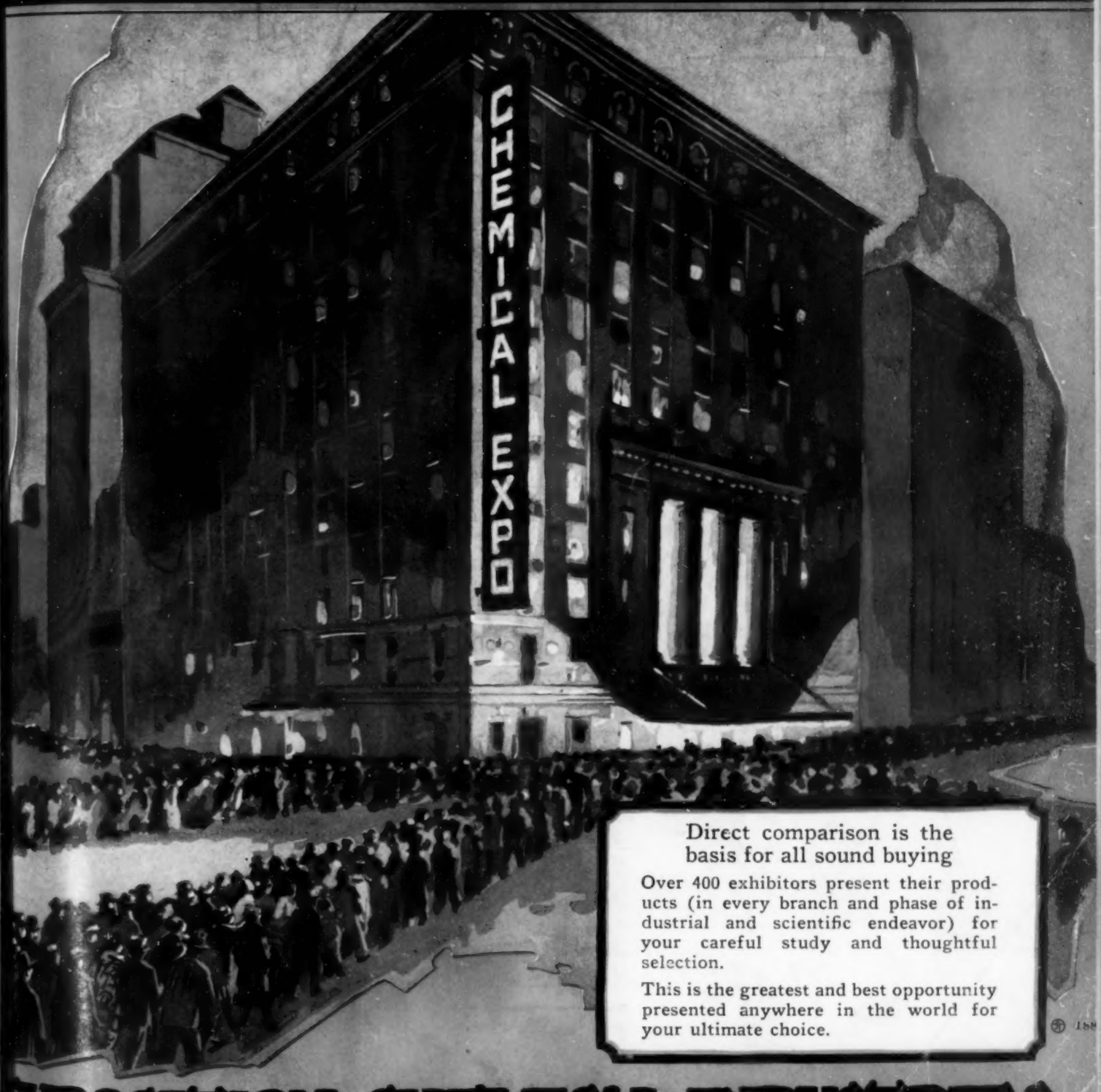
Graw-Hill Publishing Company, Inc. August, 1927 Thirty-five Cents per Copy

CHEMICAL & METALLURGICAL ENGINEERING



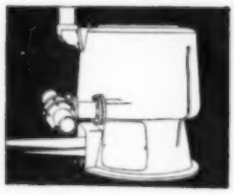
Direct comparison is the basis for all sound buying

Over 400 exhibitors present their products (in every branch and phase of industrial and scientific endeavor) for your careful study and thoughtful selection.

This is the greatest and best opportunity presented anywhere in the world for your ultimate choice.

EXPOSITION CHEMICAL INDUSTRIES

GRAND CENTRAL PALACE · NEW YORK · September 26 to October 1 · 1927



Tolhurst Specialization Gives to Industry the Centrifugal Exactly Meeting the Need

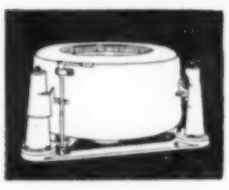
From test tube and sample work in the laboratory to big volume production, there is a size and type Tolhurst constructed of materials suited to the process: Centrifugals for reclaiming valuable by-products—Centrifugals as roughing machines in handling sludges, etc.,—Centrifugals hermetically sealed for work with volatile or toxic substances.

In this complete centrifugal service—*Specialization* plays a vitally important part. Through this concentration on the one product, manufacturers are assured upon three points. First, the Tolhurst is a superlatively fine machine. Second, the Tolhurst is built with a background of experience in virtually all processes. Third, the Tolhurst is backed by complete engineering service and cooperation.

Tolhurst engineers are at all times prepared to consult and work with manufacturers on their problems without cost and without obligation.

TOLHURST
REG. U. S. PAT. OFF.
CENTRIFUGALS

© TOLHURST MACHINE WORKS ESTABLISHED 1852. TROY, N.Y.



New York Office: 30 Church St.

Western Representative: John S. Gage, 8 South Dearborn Street, Chicago, Ill.

San Francisco Representative: B. M. Pilhashy, Merchants Exchange Building, San Francisco, Cal.

Southern Representative: Fred H. White, Independence Building, Charlotte, N. C.

Canadian Representative: W. J. Westaway Co., Westaway Bldg., Hamilton, Ont. 275 Craig, West, Montreal, P. Q.

Volume 34 *Number* 8

CHEMICAL & METALLURGICAL ENGINEERING

SIDNEY D. KIRKPATRICK
Associate Editor
GRAHAM L. MONTGOMERY
CHAPLIN TYLER
Assistant Editors

HENRY M. BATTERS
Market Editor
R. S. McBRIDE, Washington
PAUL D. V. MANNING, San Francisco
Assistant Editors

H. C. PARMELEE, *Editor*

Chemical & Metallurgical Engineering is the successor to *Metallurgical & Chemical Engineering*, which, in turn, was a consolidation of *Electrochemical & Metallurgical Industry* and *Iron & Steel Magazine*. The magazine was originally founded as *Electrochemical Industry*.

Contents, August, 1927

Editorials 465

An Economic Industrial Community 470
By CHAPLIN TYLER.

Manufacture of Sirup from Cornstalks 472

Effect of Cadmium Salts in Nickel Plating 472

Where Does Germany Stand Today In Industry and Trade 473
By EDWARD J. MEHREN.

Favorable Manufacturing Conditions for Producing Rayon 477
By SIDNEY D. KIRKPATRICK.

Conditions for Success of Low Temperature Carbonization 480
By WILLIAM EVERAND DAVIES.

Recovering Chemicals from Oilfield Brines 484

Consumption of Sulphuric Acid in Oklahoma 484

Low Temperature Carbonizations Plants Promised 484

Long Distance Transmission of Natural Gas 485
By WILLIAM MOELLER, JR.

Pigments for Coloring Portland Cement Mortar 487
By JAMES E. FOSTER.

Deterioration of Alloy Steels in Ammonia Synthesis 489
By J. S. VANICK.

New Chemical Industries in Alabama Will Follow Development of Latent Resources 493
By STEWART J. LLOYD.

Natural Resources and Manufactures of Western Pennsylvania 497
By W. A. HAMOR AND A. S. KELLER.

Book Reviews 500

- The Rayon Industry 500
- Acetate Silk and Its Dyes 500
- Soap and Glycerine Manufacture 500
- Kinetic Theory of Gases 501
- Old Chemistries 501
- Casein and Its Industrial Applications 503
- General Chemistry 503
- Inorganic and Theoretical Chemistry 503

Selections from Recent Literature-Abstracts 504

Government Publications 505

Plant Notebook 506

- Unloading Tank Cars by Compressed Air 506
- Welding High Chrominum Alloys 506
- Determining Area Required for Clarification 507
- Water Wheels for Driving Pumps 507
- Handling "Broke" at the Wet End 507

Equipment News 508

- Glass-Lined Equipment 508
- Flow Controller 508
- Speed Reducers 508
- Electrical Equipment 508
- Belt Conveyor Idler 509
- Backlash Eliminator 509
- Lead-Lined Equipment 511
- Brake 511
- Factory Truck 511
- Manufacturers' Latest Publications 511

Patents Issued July 12 to August 2, 1927 512

News of the Industry 513

- Electrochemists' Trip 513
- Cresylic Acid Duty 513
- Student Course at Chemical Show 514
- Washington News 515
- London Correspondence 516
- Paris Correspondence 517
- News in Brief 518
- Personals 519
- Obituaries 520
- Industrial Notes 520

Market Conditions and Price Trends 521

- Coke and Byproduct Activities 521
- Market Conditions 522
- Statistics of Business 523
- Review of Chemical Markets 524
- Index Numbers for Chemicals and for Oils and Fats 525
- Prices 526

Industrial Construction 528

McGRAW-HILL PUBLISHING COMPANY, INC., Tenth Avenue at 36th Street, NEW YORK, N. Y.

JAMES H. McGRAW, President
JAMES H. McGRAW, Jr., Vice-Pres. and Treas.
MALCOLM MUIR, Vice-President
EDWARD J. MEHREN, Vice-President
MASON BRITTON, Vice-President
EDGAR KOBAK, Vice-President
C. H. THOMPSON, Secretary

WASHINGTON, Colorado Building
CHICAGO, 7 South Dearborn St.
PHILADELPHIA, 1600 Arch St.
CLEVELAND, Guardian Building
ST. LOUIS, Bell Telephone Building
SAN FRANCISCO, 883 Mission Street
LONDON, 6 Bouverie St., London, E. C. 4
Member Audit Bureau of Circulations

New York District Office, 285 Madison Avenue
Cable Address: "Machinist, N. Y."
Publishers of
Engineering News-Record — American Machinist
Power — Chemical and Metallurgical Engineering
Coal Age — Construction Methods
Coal Age News — Ingeniería Internacional
Bus Transportation — Industrial Engineer
Electrical World — Electrical Railway Journal
Radio Retailing — Electrical Merchandising
Engineering and Mining Journal — Electrical West (Published in San Francisco)
American Machinist—European Edition (Published in London)

Number of Copies Printed This Issue, 12,400

The annual subscription rate is $3 in the United States, Canada, Mexico, Alaska, Hawaii, the Philippines, Porto Rico, Canal Zone, Cuba, Honduras, Nicaragua, Dominican Republic, Salvador, Peru, Colombia, Bolivia, Ecuador, Argentina, Panama, Brazil, Uruguay, Costa Rica, Guatemala, Paraguay, Chile, Haiti and Spain. Extra foreign postage in other countries $2 (total, $5, or 21 shillings). Single copy 35c. Change of address—When change of address is ordered the *new* and the *old* address must be given. Notice must be received at least ten days before change takes place.

Copyright, 1927, by McGraw-Hill Publishing Company, Inc.
Published monthly. Entered as second-class matter July 13, 1918, at the Post Office at New York, N. Y., under the act of March 3, 1879. Printed in U. S. A.

Member Associated Business Papers, Inc.

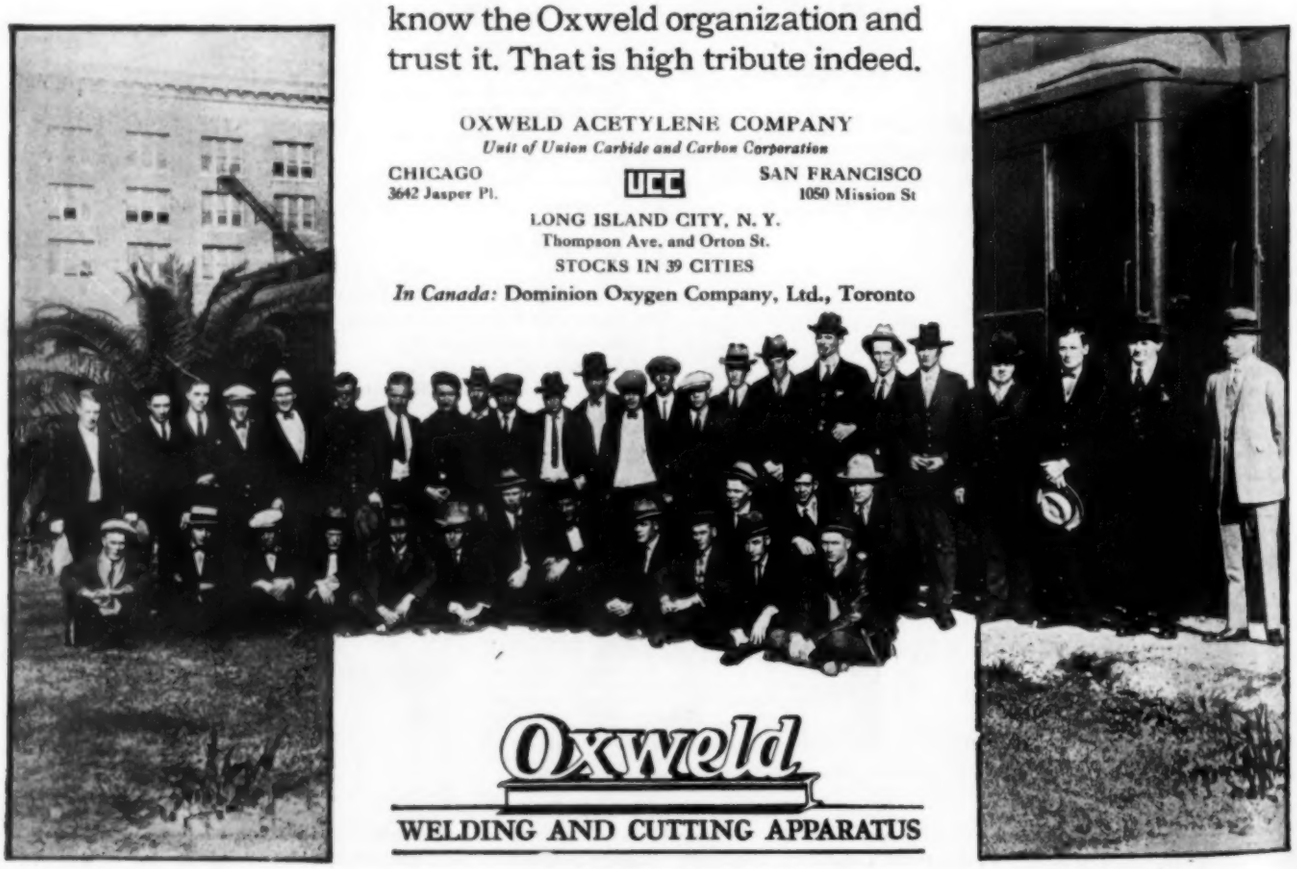
Searchlight Section, 196-203; Professional Directory, 194, 195; Ready Reference, 208, 210, 212, 214; Alphabetical Index, 216

"Please find us 30 welders"

SIMILAR REQUESTS come in to many Oxweld district offices because contractors, construction companies, and industrial men generally have come to realize that Oxweld is in touch with every kind of oxy-acetylene development and knows where good welders can be located.

Oxweld certainly does not want to become an employment agency, yet this is a definite and valuable clearing house service for Oxweld customers, which we are glad to undertake.

And again, thousands of welders who use Oxweld blowpipes also know the Oxweld organization and trust it. That is high tribute indeed.



OXWELD ACETYLENE COMPANY
Unit of Union Carbide and Carbon Corporation

CHICAGO
3642 Jasper Pl.

UCC

SAN FRANCISCO
1050 Mission St

LONG ISLAND CITY, N. Y.
Thompson Ave. and Orton St.

STOCKS IN 39 CITIES

In Canada: Dominion Oxygen Company, Ltd., Toronto

Oxweld

WELDING AND CUTTING APPARATUS

McGRAW-HILL
PUBLISHING COMPANY, INC.
JAMES H. McGRAW, *President*
E. J. MEHREN, *Vice-President*

CHEMICAL & METALLURGICAL ENGINEERING

H. C. PARMELEE
Editor

Volume 34 — New York, August, 1927 — Number 8

Centralized Fact-Finding and Information Service

IT IS common experience that next to possessing information the ideal desideratum is to know where to find it. Thus sources of factual knowledge become of the highest importance, particularly in this year of grace when the sheer body of information probably available on almost any subject is so great as to lie beyond the ken of an individual. The problem usually is to know where to find what is wanted. And the world-wide demand for information of all kinds has grown so rapidly that one is often at his wit's end to know where to look.

HENCE the pertinence of the suggestion of that experienced librarian, J. C. Dana, for the establishment in New York of an international fact center, a bureau of information for production and commerce. From his point of vantage as in a conning tower, Dr. Dana sees industries spending time and money in a search for facts and information, accumulating libraries, setting up institutes, scanning journals and transactions, calling on governmental agencies, and otherwise making "unco-ordinated efforts in the search for facts" in a manner that results in duplication of effort, waste and dissatisfaction.

TO REMEDY this "labor at cross purposes, research duplications, and gropings in the dark for facts already discovered," Dr. Dana proposes centralized information in the interest of science and industry. His mechanism would not be "a collection of books and libraries," for of those we already have many, but rather "a collection of brains, with tools proper to their work of finding facts." It would be the business of this organization to know where information is obtainable; to be familiar with world-wide sources of knowledge; to control, index and abstract all these resources.

ONE has only to observe the tremendous impetus of economics and technology in modern industry to realize the primary importance of full and exact knowledge on all phases of business. To get first the facts has become the recognized procedure. Hence the need of a central organization for fact finding that will facilitate the world-wide inquiry for information now "going on stumblingly at hazard, with meagre results." To meet this need Dr. Dana suggests out of his experience of forty years a new type of organization "for finding, securing and passing on to inquirers facts in all the arts and sciences on which all large businesses are based."

THE need for such an agency is so evident and the demand for it so imminent that, in the opinion of its proponent, it will be established somewhere in the world in the near future. The wealth and extent of American industrial, financial and commercial institutions dictate its logical home in New York. None would profit more than the chemical engineering industries, whose progress and prosperity depend on knowledge and information, technical and economic. They could well afford to support such an agency, which *Chem. & Met.* is glad to commend in the interest of efficiency.

Overcapacity Holds Opportunity for Engineers

OVERBUILDING, both as to plant area and equipment, characterized the period from 1916 to 1920. In spite of increased output by nearly all chemical engineering industries, this excess capacity has not even yet been fully utilized. This is partly because of changes in process, in equipment design, or in markets that have rendered this capacity obsolete or uneconomic for the purposes for which it was originally intended. Another factor is that industry has, in many instances, not yet caught up to the high hopes entertained during the boom days following the war.

Given this condition, it is a hard problem for the plant management to decide what to do. The ultimate hope is, of course, to find a profitable use for these facilities. Meanwhile, how shall the stand-by charges be taken care of? Shall these be apportioned to the product at present produced, thereby increasing its selling price? Shall they be written off entirely as a loss? Or, shall a special account be set up for them against the day when a profit will be realized from the present excess capacity?

Whatever is done must be dictated by the needs of the moment. But the ultimate problem remains—what shall be done with this excess capacity? It has been estimated that the chemical engineering industries are equipped to produce from 20 to 40 per cent more than the present production. The possibility of exporting such an amount under present world conditions is small. And many years must elapse before American consumption grows large enough to absorb it.

The optimist will say that the problem will solve itself in time. That is no doubt true. But meanwhile many plants are operating under the handicap of daily losses. Here lies one of the greatest opportunities for chemical engineers today. The man who can change the red ink to black in one of these burdened plants will assure his future.

Students' Course at the Exposition

WITH THE RETURN of the chemical exposition to Grand Central Palace, New York, plans are being made to revive the educational course for chemical engineering students during the week of September 26. This has been a notable feature of the last two expositions, and those institutions and individuals that embraced the opportunity have profited in no small measure. The underlying idea is sound. The exposition comprises equipment in great variety illustrating the principles and industrial practice of chemical engineering. At no other time and place can one view so complete an assortment of apparatus. What more logical than to combine lectures and quizzes with inspection trips to illustrate the principles discussed in the class room?

Profiting by earlier experience, the course this year will be better organized and conducted than ever before. Two groups of students will be recognized, elementary and advanced, and the work will be planned to meet their respective needs. There will be morning lectures by experts on various phases of chemical engineering, with quizzes to see that the subject is thoroughly understood. These will be followed by conferences at which equipment will be illustrated and described. With this preparation the students will then inspect appropriate exhibits under the direction of competent guides and discuss with manufacturers the details of construction and operation of their equipment.

For technical schools within a day's trip of New York the plan offers an exceptional opportunity. The exposition becomes for the time being a huge equipment laboratory in which the student can be assigned a week of intensive study. Classes on the campus can be transferred temporarily to the exposition, where lectures, quizzes and inspection trips can be made a part of the required college work. Final examinations will be given by the director and the results submitted to the colleges as evidence of the student's accomplishment. In short, the course will be no haphazard project in which the student is left to his own devices, but an organized effort to control and direct his activities. Professors of chemical engineering should plan now to visit the exposition with their students, formally register them for the course and assist them in getting the most out of it.

Who Owns Patents of Government Employees?

AT LEAST one phase of the vexed question of the patent rights of government employees has been settled in the courts. The principle involved was the ownership of a patent granted to a government employee, embodying the solution of a problem to which he was specifically assigned. The District Court of Maryland decided that the invention and the patent application covering it are the property of the United States and not of the employee.

It appears from the record that H. W. Houghton was an assistant chemist in the Public Health Service. Among the problems engaging the attention of the Service was the fumigation of ships, buildings and other enclosures with hydrocyanic acid gas; and particularly a method of making the gas safe by adding thereto a warning constituent such as the tear gases developed by the Chemical Warfare Service. A co-operative study was arranged between the Public Health Service and the Chemical Warfare Service and Houghton was appointed a member of a board under the control of the Surgeon General of the Public Health Service to investigate the problem. Experiments were conducted at Edgewood Arsenal where Houghton and three others were assigned to the work. The plan suggested by Houghton was considered practicable and was finally carried to a successful conclusion.

Immediately after the discovery Houghton took up with his superior officers the advisability of patenting the method. There was conflicting opinion as to the proper procedure and before a decision was forthcoming Houghton filed an application in his own name. Shortly thereafter the employees at the Arsenal dedicated their rights to the public. Finally the solicitor of the Treasury declared that the sole title to the invention resided in the United States. The suit in question was then entered to determine title to the invention.

In the course of his opinion the Court quoted the following rule laid down by the Supreme Court in the case of Solomons v. United States:

> If one is employed to devise or perfect an instrument, or a means for accomplishing a prescribed result, he cannot, after successfully accomplishing the work for which he was employed, plead title thereto as against his employer. That which he has been employed and paid to accomplish becomes, when accomplished, the property of his employer. Whatever rights as an individual he may have had in and to his inventive powers, and that which they are able to accomplish, he has sold in advance to his employer.

This rule with respect to government employees is parallel to that laid down by the Courts for private employees who are clearly regarded as having no rights in patentable inventions or discoveries resulting from investigations for which they were specifically employed. Apparently in these cases the employees are paid to accomplish certain ends which, when accomplished, are the property of the employer. The rule seems equitable

Oil from Coal as a New World Industry

BY ITS REPORTED PURCHASE of the American rights to the Bergius process for the liquefaction of coal, the Standard Oil Company of New Jersey becomes a partner in an international combine of startling ramifications. The actual agreement is with the German Dye Trust, amounting to a half interest in the Deutsche Gasoline Aktien Gesellschaft which is the sales organization of the I. G. Farbenindustrie for motor fuel. But the I. G. in turn is a licensee of the International Bergin Company of The Hague, and associated in one way or another with that organization are some of the largest industries of the world. The Royal Dutch Shell, for example, is a party to one arrangement; the Schneider-Creuzot interests control rights for France, Belgium, and Luxembourg, and sharing with the I. G. in Germany are companies that represent Stinnes, Fritz Thyssen, Dr. Spilker and other steel and coal operators of the Ruhr as well as the Gesellschaft für Teerverwertung which controls the major share of Germany's coal-tar production.

Just why the Standard Oil Co. should wish to join in such an international attempt to produce synthetic petroleum products remains a matter of much conjecture in the United States. It has been generally known for some time that negotiations were in progress between the Standard Oil Company and the German Dye Trust looking to a possible exchange of patents and agreements on the use of facilities controlled by each organization. American representatives visited I. G. plants in the spring of 1926 and there have been several German delegations in this country on various technical commissions. It has been known further, that there has been a mutual interest in anti-knock compounds such as tetra-ethyl lead and iron carbonyl and that certain patents controlled by the Standard company on the production of isopropyl alcohol from gas were possible of extended application in Germany. It is conceivable, therefore, that a certain amount of negotiation and trading might have been to the mutual advantage of both organizations.

As far as any American interest in synthetic motor fuel is concerned, it is apparent the Standard Oil Company must be anticipating a demand that lies in the very distant future. In spite of the optimistic cost estimates that are supposed to have had their origin in the experimental Bergin plant at Merseburg, we know that the Germans will have to go a long way to meet the present low cost of producing and refining petroleum in the United States. It is well, therefore, that the Bergin process is to have its commercial trial in a country less favored with petroleum resources and without a highly developed refining industry.

Electrolysis of Water at High Pressures

RECENT INVESTIGATIONS carried on by Lawaczeck and Riepel of Munich and observed by Prof. Stewart J. Lloyd during a recent European trip indicate the economic possibility of electrolyzing water at high pressures, thus generating the hydrogen and oxygen in a form suitable for transport through long pipe lines or for utilization in ammonia synthesis.

The investigators point out that hydrogen, no matter how generated, must be highly compressed in any of the synthetic ammonia processes, regardless of whether the Casale, Claude or Haber method is to be followed, and that the compressors are a fruitful source of trouble, both in their design and operation. Lawaczeck and Riepel claim that their electrolytic cell eliminates these troubles by generating the hydrogen at the particular pressure desired, even up to 1,000 atmospheres.

The electrolyzer as now developed comprises a vertical steel cylinder inclosing the unit electrode "packages" which are assembled one above another and connected in series. One particular installation contains three of these packages in a cylinder 1 m. high. The cylinder may be made as long as desired, and of course the number of packages will increase in proportion. The electrodes are of perforated nickel, separated by asbestos-cement diaphragms not more than 1.5 mm. thick. The perforations are arranged in such manner that the gases are liberated on the sides of the electrodes away from the diaphragm.

As would be expected, the consumption of energy to produce a given weight of hydrogen and oxygen decreases as the pressure at which the cell operates increases. This observation has been confirmed recently by Coehn.

The cell appears to be quite flexible. At a current density of 600 amp. per sq.m. of electrode surface and 1.7 volts pressure, 1 cu.m. of hydrogen is produced with an energy consumption of 4.25 kw.-hr. Increasing the current density to 1,350 amp. per sq.m. the energy consumption became 4.85 kw.-hr. A cylinder 1 m. in diameter and 14 m. high will consume 1,000 kw. and will produce 235 cu.m. of hydrogen per hour. The cell requires only one-third the floor area required by other types. The electrolyte is potassium hydroxide.

The problem of equalizing the pressures on the two sides of the cell in order to prevent mixing of the gases is difficult, but the inventors claim to have solved it, as well as the many other troublesome features of design incidental to high-pressure equipment. Some successful experiments have already been made in transmitting the compressed gases long distances, and there is reason to believe that the high-pressure gas transmission line will prove to be cheaper than the equivalent electrical line. That is, it may be economically feasible to generate hydrogen electrolytically at the coal mine or water-power site and transmit it to the consumer, rather than trans-

mit the equivalent in electrical energy to the same point.

Recent advances in water gas manufacture, comprising the use of a mixture of steam and oxygen to effect a continuous instead of intermittent operation, support the belief that even when the bulk of hydrogen for ammonia manufacture is derived from coal or coke, it may be wise to install a relatively small block of electrolytic cells, adding the hydrogen thereby produced to that from the water gas and using the oxygen in the producer. For such a purpose the pressure cell of Lawaczeck and Riepel may prove of significance.

Developing International Outlook in American Chemical Industry

AMERICAN industry of all sorts has been prone in the past to be provincial in its outlook and wholly uninterested in foreign markets. Of late years this condition has been rapidly changing, largely because of the splendid work of the Bureau of Foreign and Domestic Commerce in bringing about a realization that foreign trade is often a vital balance wheel on American business. In this fine work the chemical engineering industries of the country are finding much helpful information available from the bureau in the way of trade opportunities and are being stimulated to do some sound economic thinking.

At the recent sessions of the National Fertilizer Association this line of activity had further effective handling through an address by C. C. Concannon, chief of the chemical division of the bureau. Mr. Concannon's remarks not only brought deserved attention to the fact that there were large foreign market possibilities for the fertilizer man as well as for the phosphate rock producer; it also drew attention to the serious threat now hanging over the industry if it will not realize that it must take account of foreign manufacturing methods and trade practices.

No effort was made by Mr. Concannon to stress unduly the German proposals to introduce nitrophoska into the United States, but he did well to point out that this possibility is one far too serious to be ignored as it has been among fertilizer men. All chemical engineering industries indeed must take account of the continuing efforts of the great German chemical trust, the I. G., to rebuild the industrial supremacy of Germany by entering not alone Far Eastern and Latin American markets, but also by actual invasion of the United States in competition with American producers.

Forecasts in this field are hazardous, but any tendency of any branch of the chemical engineering industries to play ostrich and ignore the industrial possibilities of foreign competition is unwise. We need to develop a realization in these industries that the world is now a very small place. Rapid means of transportation and communication, intensive ship competition giving low water freight rates, and many other factors make all the ports of the world today as close neighbors as were the Eastern Seaboard ports of the United States barely a decade or two ago. Distance is no longer a bar to competition in many fields, among them even some in the heavy chemical industry. Every branch of the business needs, therefore, to develop that international consciousness which will enable it rightly to appraise and effectively to plan for trade relations in foreign countries as well as at home.

New Technology Points the Way Out

FOR MORE THAN a year a great company rich in chemical history and tradition has been engaged in a heroic struggle to pull itself out of the slough of financial troubles. Whether it was mismanagement, technical stagnation or the uncertainties of chemical industry that brought the Celluloid Company of New Jersey so near disaster, is a question of purely academic interest. The important point is that in less than a year a new management, brought in from an entirely different industry, has put the affairs of the company on a sound basis and has now paved the way for a technical development that holds unusual promise.

On July 29 Robert Campbell, president of Celluloid, announced plans for merging his company with the Celanese Corporation of America with the ultimate intention of large-scale manufacture of non-flammable plastics and allied products made from cellulose acetate. There is thus brought together two companies of quite different experience and background yet each of which can be expected to contribute greatly to the new program. The Celluloid Company dating back fifty-seven years to the basic Hyatt patents, has pioneered in the plastics industry. John H. Stevens, who was associated with Hyatt in the original development, introduced the use of amyl acetate and other nitrocellulose solvents that form a part of the foundation of our present lacquer industry. Likewise in developing tri-cresyl phosphate as a camphor substitute, the company contributed to later progress of both plastics and lacquers. More recently the brilliant researches of the late W. G. Lindsay on cellulose acetate solutions and motion picture films, have made their impression on industry. Yet from all of these achievements the Celluloid Company prospered but little.

Much shorter but equally significant from both technical and commercial viewpoints has been the history of the Celanese Corporation. Its parent organization, the former British Cellulose & Chemical Corporation, was the outgrowth of war experience. It was the production of "dopes" for coating the wings of airplanes that gave the two Swiss chemists, Drs. Camille and Henri Dreyfus, the interest in cellulose acetate which eventually led to the development of Celanese silk and cellulose acetate films. In less than ten years this production has grown to international importance.

It is only natural that the related field of plastics should be the magnet that brings the two companies together. In experiments to improve its products or develop new materials of superior quality, the Celluloid Company found itself able to produce highly satisfactory plastics from cellulose acetate. The new product was non-flammable and in other ways superior to ordinary pyroxylin, but the high cost of the experimental product seemed an impassable barrier to the Celluloid Company. However, the large-scale production of cellulose acetate is the business of the Celanese Corporation and presumably through its fusion with the Celluloid Company we may expect shortly to see the economical and commercial production of the new non-flammable plastics.

The merger marks the culmination of a year of remarkable progress in the affairs of the Celluloid Company. Mr. Campbell and his associates by vigorous and intensive reorganization and adjustment put the company on the basis of profitable operation. Now, by the turn to a new technology, the way is opened for a pioneering achievement of unusual industrial significance.

Cresylic Acid Tariff and American Coal-Tar Industry

NEWSPAPERS throughout the country have shown unusual interest in the President's recent proclamation reducing by fifty per cent the import duty on cresylic acid. This is the first instance in which the discretionary powers of the so-called flexible tariff law have been used for reducing an existing duty, and, coming at a time when the atmosphere is already overcharged with politics, it is natural that the press should look for a partisan motive. A more significant technical point which seems to have been overlooked in most recent discussions, however, is to be found in the statement made public at the Executive Offices at the same time as the proclamation. In it there appears to be either a lack of understanding of the coal-tar situation or an attempt to direct attention from the true reason for the tariff reduction.

After commenting on the various industrial uses for cresylic acid and the fact that it is produced in the distillation of coal tar from coke-oven or coal-gas plants, the statement gives the following explanation of the apparent deficiency of the American coal-tar industry:

> In Great Britain, in addition to coke-oven tar, large quantities of coal-gas tar, which is especially rich in cresylic acid, are utilized as a raw material. In the United States the water-gas process for making illuminating gas has to a large extent replaced the coal-gas process. Water-gas tar contains practically no cresylic acid. Great Britain has exported more cresylic acid both dutiable and free, than any other country within recent years.

The natural assumption from this statement is that there is insufficient raw material in the United States and it is for that reason we must rely on our British cousins for most of our supply of creslyic acid. The facts of the case, of course, are that we have such an abundance of tar from our byproduct ovens that at least fifty per cent of it is burned in open-hearth steel furnaces in competition with fuel oil. Of the 150,000,000 gallons of byproduct tar annually distilled in this country, only a very small fraction is actually refined to produce the tar acids and other coal-tar chemicals. The reason is not because of any lack of demand for cresylic acid, but rather for pitch and the other refined products. Given a balanced market for all refined products, the American coal-tar industry is capable of producing many times the present requirements of either cresylic acid or cresol U.S.P.

The statement from the Executive Offices further errs in the implication that the water-gas process has become the dominant American method of making illuminating gas. As a matter of fact, the evident trend has been toward the increased use of the coke oven in supplying city gas, and the quantity of coke-oven tar has greatly increased in recent years, while water-gas, oil-gas and retort tars have been gradually declining.

These criticisms, to be sure, are quite apart from the President's action in ordering a reduction in the duty on cresylic acid. That was the logical move based on the actual difference in production costs as ascertained by the Tariff Commission. It is an important service to the consuming industries and will doubtless help in the solution of a complicated problem in customs administration. But whoever was responsible for the explanatory statement should have been better advised as to his comments on the American coal-tar industry.

Dollars and Sense and the Nation's Health

STRIKING ECONOMIC PROGRESS made in the United States through the checking and control of disease and the improvement of sanitary conditions, and the vast possibilities of still greater progress are reflected in a bulletin on health and community prosperity issued by the Insurance Department of the Chamber of Commerce of the United States. Executives in all industries should familiarize themselves with the contents of this bulletin and take more active steps to correct conditions that entail a preventable economic loss and waste in American industry.

As a measure of the annual economic loss to the country the bulletin cites estimates of $2,000,000,000 through illness and $6,000,000,000 due to premature death. On the other hand impressive gains are recorded through the more effective control of widely prevalent diseases such as tuberculosis, diptheria, typhoid, influenza and pneumonia. Based on the reduction of the tuberculosis rate since 1900, an estimate of $2,000,000,000 is cited as being the annual saving in this field alone.

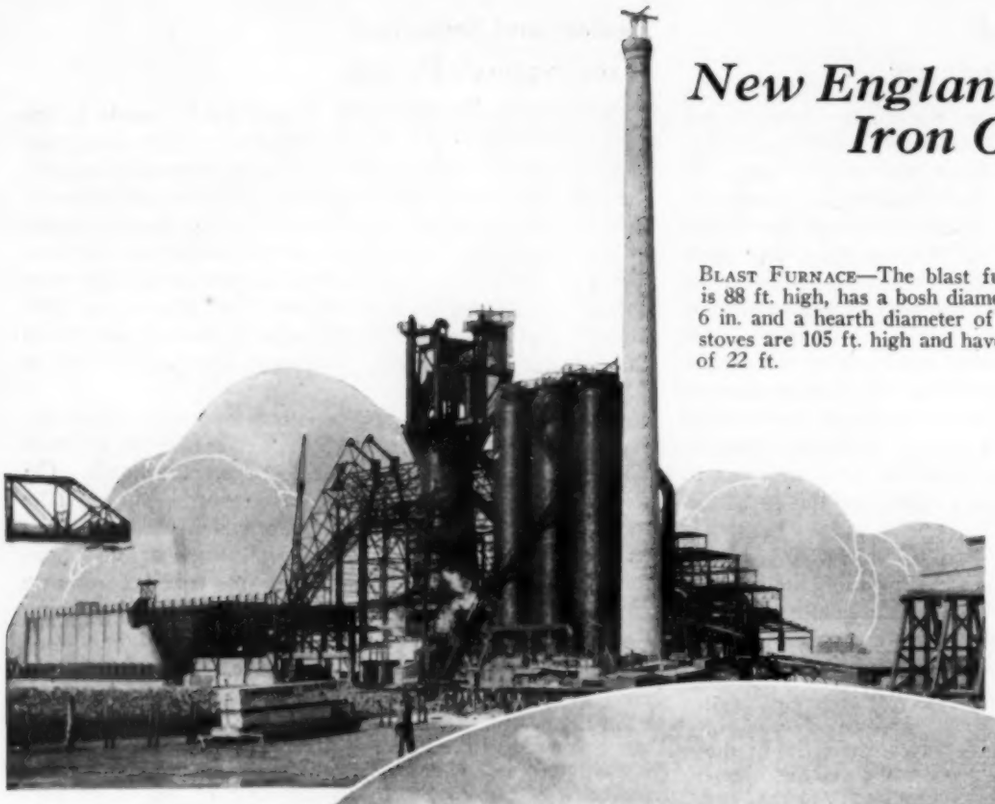
The ability of a man to work, says the Insurance Department of the National Chamber, depends in large measure upon his health. Whatever reduces his earning capacity in any way reduces the assets of the community. Any decrease in earning power is naturally reflected in reduced purchasing power with the result that every case of illness or premature death involving loss of wages has an effect upon the community. This may not be noticeable in individual cases, but the total sum is tremendous.

It is generally known, the bulletin continues, that a large proportion of all deaths occurring may be prevented through simple precautionary measures. During recent years remarkable progress has been made in decreasing fatalities from such diseases as smallpox, diphtheria, typhoid fever, tuberculosis, measles, scarlet fever, whooping cough, influenza and conditions causing the deaths of infants.

Preventive measures have at the same time reduced the number of cases of sickness from these diseases. The saving from reduced illness is not easily measured, but the number of cases reported and the time lost from work or school are fairly satisfactory standards to indicate the incidence and severity of morbidity. The cost of illness to industry has never been determined nationally, but one prominent manufacturer with an annual payroll of approximately $5,000,000 estimates the total annual cost of illness to his business, including charges for idle machinery and loss in production to be $287,500. The loss to the individuals and the community due to the illness of his employees is estimated to be $303,000 annually. This takes into consideration direct loss of wages, indirect loss of earning capacity after illness, medical and nursing expenses, public expenses and charitable relief.

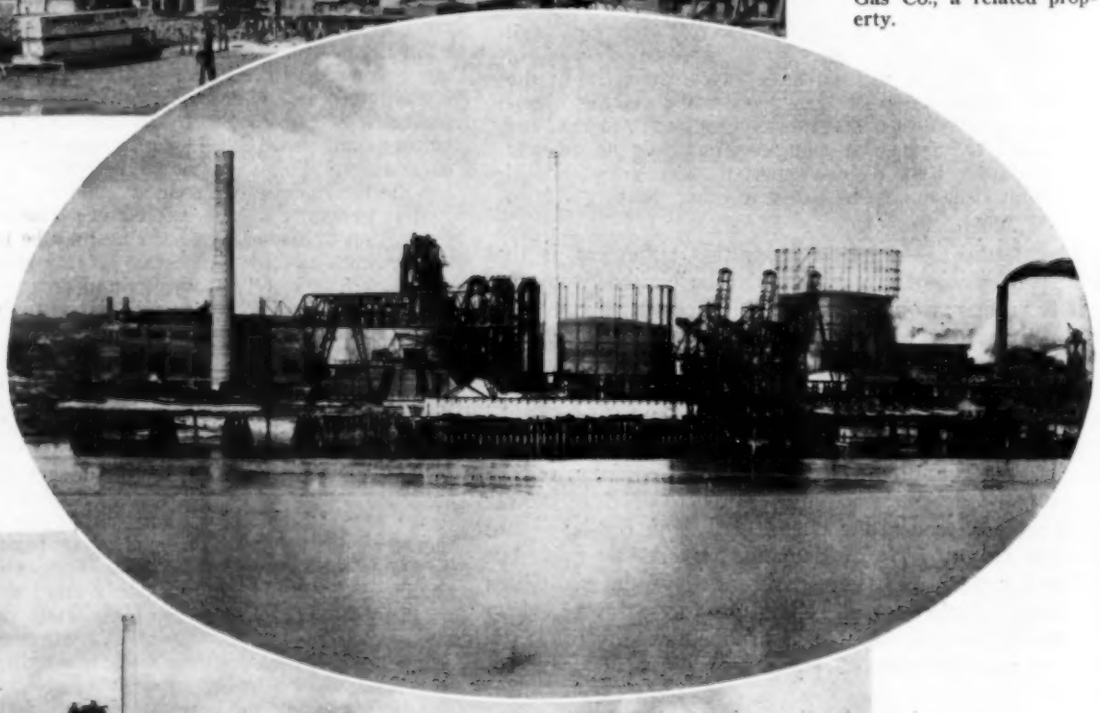
Assuming that there may be considerable disagreement as to accuracy and statistical method of the foregoing estimates, there can be no reasonable doubt that the verifiable losses to industry through illness and premature death are enormous and therefore constitute a blot on our record as a civilized nation. The loss is deplorable because for the most part it is indicative of carelessness and neglect and gross ignorance of the abundant machinery of the United States Public Health Service, to say nothing of municipal and state clinics and the almost universal free or low-cost medical service available to the industrial worker. The remedy probably lies in an even more vigorous continuation by employers of present health and safety educational campaigns. The worker must be taught to regard his own health and that of others with a respect equal at least to that which he now has for the inanimate machinery of production.

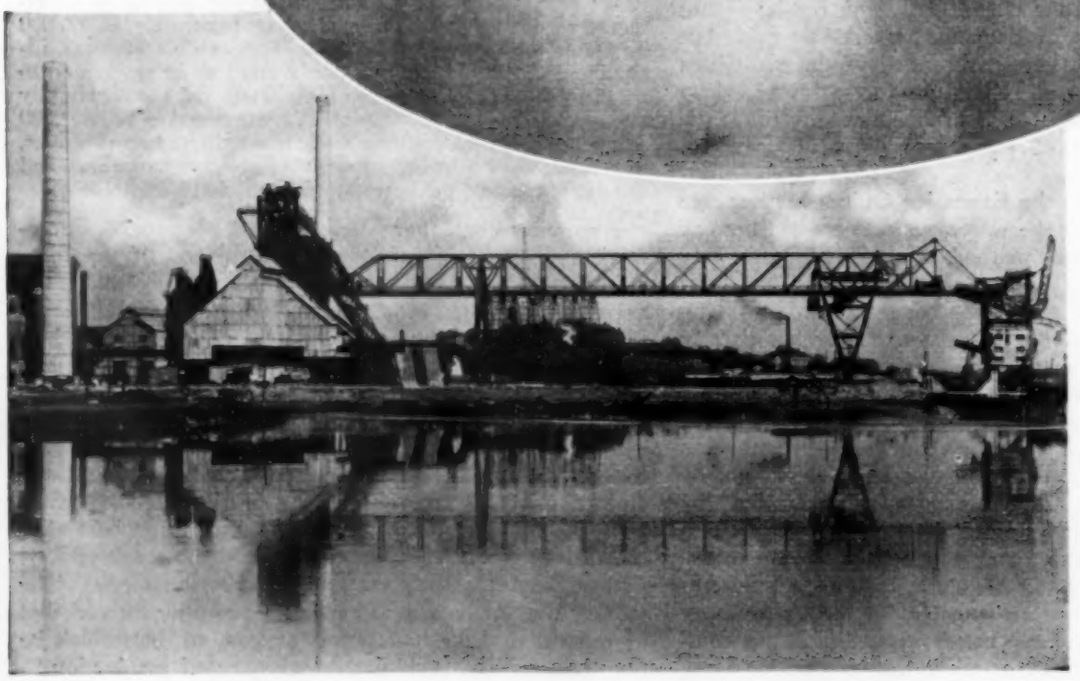
New England's Fuel and Iron Center



BLAST FURNACE—The blast furnace stack is 88 ft. high, has a bosh diameter of 22 ft. 6 in. and a hearth diameter of 17 ft. The stoves are 105 ft. high and have a diameter of 22 ft.

CENTER: THE MYSTIC IRON WORKS—From left to right can be seen the boiler house, engine room, ore bridge, blast furnace and stoves and the ore unloaders. In the background are the holders of the Boston Consolidated Gas Co., a related property.





ORE BRIDGE—The ore bridge has an over-all length of 450 ft. and a clear span of 250 ft. The 8-ton bucket can handle 450 tons of material per hour.

An Economic Industrial Community

Mystic Iron Works which supplies one-third of New England's pig iron is example of well-chosen plant location

By Chaplin Tyler
Assistant Editor, Chem. & Met.

CHEAP transportation of raw materials and the cultivation of a rich local market are the principal factors which have established the Mystic Iron Works of Everett, Mass., as an economic producer of pig iron. At present, this company, which is a subsidiary of the Massachusetts Gas Companies, is supplying about one-third of New England's pig iron, and plans are being made to further satisfy this market.

A consideration of the fundamental factors in plant location will show that the enterprise is fully justified and was a logical development, both for the Massachusetts Gas Companies and for New England's industrial structure.

Geographic Location. The iron works occupies 65 acres fronting on the north shore of the Mystic River in Everett, Mass. This site is part of a peninsula of 325 acres bounded by the Island End and Mystic Rivers and which is owned by the Massachusetts Gas Companies.

Raw Material Sources. At present, ore is obtained from five sources. Wabana ore comes from Nova Scotia, and is a high-phosphorus ore containing about 52 per cent of iron. The Ouenga ore from Algeria is a high-manganese ore containing about 52 per cent of iron. Douaria is another African ore and contains about 55 per cent of iron. Captan, a high-grade Swedish ore, contains about 65 per cent of iron and is fairly high in phosphorus and manganese. Sintered ore containing about 65 per cent of iron is obtained from Port Henry, N. Y. Of the various sources of ore, Algeria is the most distant and the freight for this transportation is between $1.75 and $2.00 per ton.

THE limestone is shipped by water from Rockland, Me., and high-grade metallurgical coke is obtained from the adjacent plant of the New England Fuel and Transportation Co., another subsidiary of the Massachusetts Gas Companies. Condenser water is pumped from the Mystic River.

Markets. New England is considered to be the only economic market for pig iron from the Mystic Iron Works. According to a recent estimate of the New England Foundrymen's Association, the annual consumption of pig iron in the six New England states is 475,000 tons. Of this quantity, the Mystic Iron Works can supply from 140,000 to 150,000 tons, or about 500 tons per day. It can be seen that the consumption within this area is large enough to assure continuous operation of the present furnace and of another of similar capacity. Assuming reasonably low production costs at the furnace, the freight differential within the New England area is the deciding issue. No attempt is made to diversify production, and the furnace operates on one grade only, foundry pig.

Transportation. Before the furnace was erected the channel of the Mystic River was deepened 30 ft. below mean low water, or sufficient to pass ocean-going freighters of 10,000 tons displacement. Consequently, all-water transport of ore and limestone is the rule. Connections have, of course, been made with the lines of the Boston and Maine R.R. and with the interplant rail system of the Massachusetts Gas Companies. Flexible and effective means of transportation is therefore available throughout the year.

Sources of Fuels and Power. The boiler plant is designed to utilize either blast-furnace gas or coke breeze; consequently fuel costs are a minimum. All power is generated at the plant, and process steam not used at the furnace is delivered to the coke ovens through a 10-in. main 3,000 ft. long.

Labor Supply. Labor supply has not been a problem at this plant. The plant is in New England's largest industrial center, the Boston district, and for a plant of this size a large operating force is not necessary.

Relation of Plant to Other Industries. Reference has been made to other subsidiaries of the Massachusetts Gas Companies. Among these and whose plants are nearby, are the coke-oven plant of the New England Fuel and Transportation Co., the coal-handling plant of the New England Coal and Coke Co.; the water-gas plant of the Boston Consolidated Gas Co.; and the petroleum refinery of the Beacon Oil Co. Without question the integration of these plants has operated to mutually lower production costs, particularly through large scale handling of fuel and fuller utilization of certain byproducts such as coke breeze, electric power and process steam. It is likely also that organization costs have been reduced proportionately.

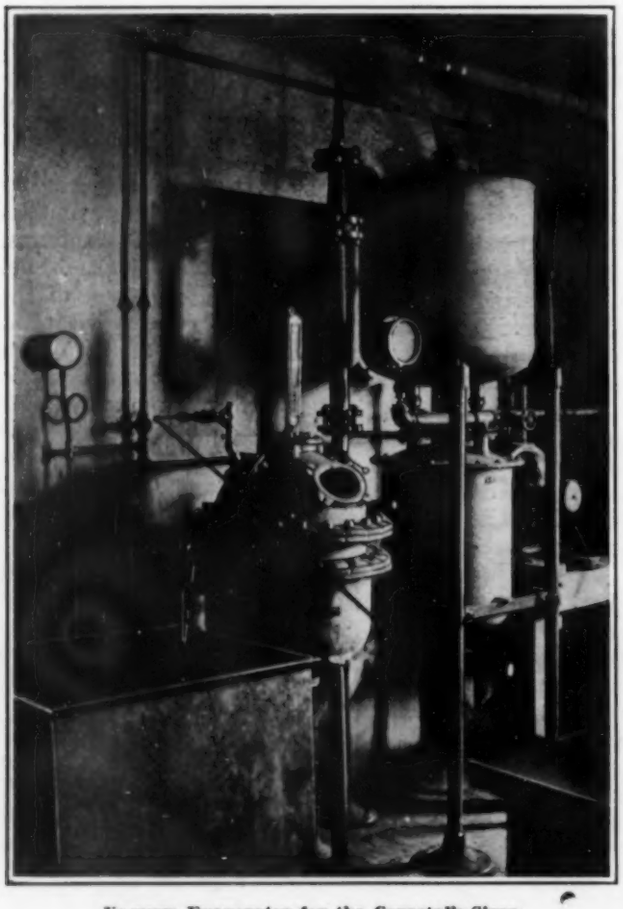
Certain features of the plant should be of interest, even to those not engaged in iron production. The unloading wharf is 320 ft. long and is constructed of reinforced concrete on oak piling. Ore and limestone are taken from the boat by three unloaders, which weigh and dump the material into a 10,000-ton concrete intermediate storage bin on the wharf. From here the material is transferred by an ore bridge either to the storage yard or direct to the furnace stock bin. The ore bridge, which is 450 ft. over-all length, can handle 450 tons per hour. Normally more than 100,000 tons of ore is held in storage, and limestone is of course stored in proportion. The storage yard was formerly a salt

marsh, which prior to starting operations, was filled with gravel and sand so that the grade is now 17 ft. above mean low water.

The blast furnace is 88 ft. high and has a bosh diameter of 22 ft. 6 in. and a hearth diameter of 17 ft. It is charged by two 10-ton skip buckets, which lift the material up an incline 125 ft. long. The three blast stoves, each 105 ft. high and 22 ft. in diameter, have sufficient heating capacity for an additional furnace. A stack 225 ft. high and 7 ft. top diameter serves the stove.

AS cheap fuel must be utilized in order to keep down costs, the boiler plant was designed to utilize these. There are six 800-hp. boilers which operate at 225 lb. pressure and 125 deg. F. superheat. Several of the boilers are fitted with furnaces designed to burn blast-furnace gas of about 95 B.t.u. and the others are fitted with Coxe stokers which handle coke breeze and bituminous coal without difficulty. The boiler house consumes all the blast furnace gas not needed for the stoves and all of the screenings from the blast-furnace coke. The rest of the fuel comprises coke breeze and coal from the nearby coke ovens. As mentioned previously, an economical steam balance is maintained by selling the excess to the coke ovens, which are supplied through a 10-in. main, 3,000-ft. long.

The power house equipment comprises two 5,000-hp. turbo-blowers operating at 4,600 r.p.m. and each of which will deliver 45,000 c.f.m. at 30-lb. pressure; two 750-kw. turbo-generators which operate at 2,300 volts a.c. and two 500-kw. motor-generators which operate at 250 volts d.c. Condenser water is pumped from the Mystic River by three motor-driven pumps.



Vacuum Evaporator for the Cornstalk Sirup.

Manufacture of Sirup from Cornstalks

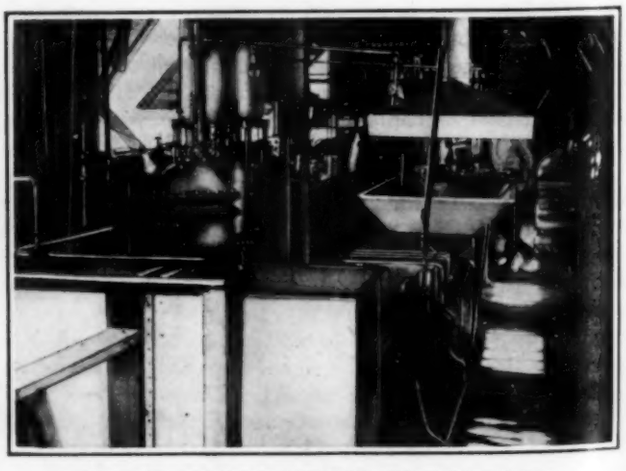
THE agricultural experiment station of the University of Minnesota has operated for two years an experimental plant for making sirup from cornstalks. In the process the stalks are cleaned of ears, leaves and tassels and then are crushed in a three-roll mill. The juice is heated to boiling and a scum allowed to form. The filtration of the juice is simplified by the removal of this scum through skimming. After filtration the juice is evaporated.

The cornstalk sirup is usually clear, of a reddish amber color and possesses a mild, agreeable flavor. As it is not a table sirup it might have a wide use in cooking similar to that of sorghum or molasses.

The experimenters set a price of $3 a ton for fresh stalks as a possible satisfactory price to the grower and one which could be paid by a corn canning establishment which would equip for making the sirup. This is equivalent to from 18 to 21c. a gallon for the sirup and the cost of manufacture is estimated at 30c. The price at which the sirup could be sold would thus compete with that paid for the best grade of sorghum sirup.

Effect of Cadmium Salts in Nickel Plating

AN INVESTIGATION was recently conducted at the University of Maine by Prof. H. C. White and K. L. Proctor to determine the brightening effect of cadmium salts in still nickel plating solutions. Standard plating solutions and the usual commercial current densities were used. The percentage of cadmium chloride in the bath was increased in each succeeding run by 0.01 per cent. The deposit became increasingly brighter as the percentage of cadmium salt was increased, up to 0.05 per cent. From this point to 0.10 per cent there was apparently no change. Above 0.10 per cent the deposits gradually became poorer in quality, and with 0.50 per cent the deposit was bad and black in color. The proper range, then, to obtain the maximum brightness is between 0.05 and 0.10 per cent cadmium chloride. With agitated baths, results showed that the values are somewhat different, and the values are now being determined for this type of bath.



Experimental Plant for Making Cornstalk Sirup.

Where Does Germany Stand Today In Industry and Trade?

By Edward J. Mehren
Vice-President, McGraw-Hill Publishing Company, Inc.

"WHAT is happening in Germany?" has been a leading question with Americans ever since the war. During the inflation period, we were disturbed at the low-priced goods she shipped to us. Her competition is still felt in some of our home markets, while reports of her activities in industrial consolidation and cartels prompt frequent repetition of the question. An exact, but brief, answer is not easy to give. The evidence in some matters is conflicting, indicating that there is still unsettlement. Nevertheless, the general situation can be stated briefly, and answers hazarded to those obvious collateral questions, Whither is the Reich going? How far will it go?

To begin with, let us build a background. Here is a nation that had grown to industrial greatness in a generation. Then she was pushed from her high estate. Through the Versailles Treaty she lost 13 per cent of her area, 10 per cent of her population, 20 per cent of her coal mines, 74.5 per cent of her iron ore, and 68.3 per cent of her zinc ore. Her colonies were seized, her merchant shipping wiped out, her foreign investments largely confiscated. But that was not all. Inspired by the new nationalization growing out of the war, and crystallized by the application of the theory of "self-determination of small nations," custom barriers sprang up all over Europe and cut off markets. Russia practically disappeared as a buyer. The British colonies adopted Empire preference policies. Finally, Germany experienced a revolution and a financial debacle that wrecked her economic structure.

In the light of this discouraging background, where stands the Reich today? Whither is it going? How far will it go?

FIRST, let it be said, progress since 1924 has been astonishing. The industries are effectively organized, the workers are fairly well satisfied and are working diligently, the general spirit of unrest and discontent has disappeared, although some claim that this is only on the surface. Above all there is a drive and a spirit of sacrifice and devotion among the leaders and managers of industry and trade that is inspiring. They do not know how long it will take to reach a truly stable economy, with the workers on a satisfactory standard of living and with industry on a reasonable net earning basis. But the immediate tasks are clear and to their solution the leaders of German commerce, industry and engineering are applying tremendous energy, intelligence and patience. The workers in large part have recovered from their post-war radicalism and are working with an industry that wins general approval from employers. They, too, have caught the spirit of sacrifice.

Just now business is active. Mills and factories are running to good capacity. The number of unemployed, which reached 2,000,000 in January, 1926, has gradually declined, standing at 649,000 at the end of May. But it is feared by some close students of industry that the present demand for goods will not keep up. The stimulated production is for German use and not for export, and these students failed to see a sound basis for heavy internal buying. Indirectly the present improved situation is due largely to the British coal strike and to some extent to the Russian orders taken last year. Conditions just now are favorable, relative to the situation late in 1925 and early in 1926, but the economic situation is still abnormal and must remain so for many years.

The overshadowing adverse conditions are lack of capital and burdensome taxation. The meager supply of capital hampers chiefly in inability to finance foreign trade, but it imposes a second handicap through the inability to make plant improvements that will help reduce production cost. Moreover, the increase in the supply of capital will be slow, except for foreign borrowing. Taxes are too high to permit of rapid capital accumulation by industry itself and by the public.

The second major industrial handicap is taxation, and this works in two ways, first, by taking large percentages of net profit from the industries themselves and, second, by taking so much from the individual that he has little to invest in industrial securities either directly or through savings and insurance deposits. In total the taxes on moderate sized and large companies run from 40 to 50 per cent of the annual net income.

Taxation of individuals is also heavy and varied. Income taxes start at 10 per cent on incomes over 1,200 marks, rising to 45 per cent in the highest bracket. Then there are church taxes, legally imposed, amounting to 25 per cent of the income tax paid to the government; an annual tax of ½ per cent on one's whole fortune and very heavy real estate taxes. An individual's personal taxes may well run over 50 per cent of his income. Therefore, if an individual's income is entirely from stock holdings, 75 per cent of the net profit on his shares would go to the government.

When people talk of their tax burdens here in Germany it is quite common for them to place special stress on the reparations payments made under the Dawes Plan. They regard these payments as the principal cause of the high taxation. As a matter of fact the Dawes payments for the year ending Aug. 31, 1927, certainly are less than 12½ per cent of the total taxation of Germany, including the taxation of the Reich, the states and the communes.

But there are still other burdens and handicaps. There is, for example, what is generally called here the social burdens. These consist of the payments which industry

must make to special funds, such as those for sickness insurance, unemployment and invalid and old age pensions. These payments are in addition to the requirements of the budget for extraordinary assistance to unemployment and sickness insurance funds. The extents of these burdens can be shown by a few examples.

In a recent report the I. G. Farbenindustrie A. G., the largest corporation in Germany in point of capital, stated that its costs for social burdens imposed by law amounted to 5 per cent of its total wage payments. That is, for its 88,152 employees, the company's disbursements for social purposes were 11,800,000 marks. In a large heavy machinery corporation the social burden is 6.55 marks per ton of product as against 2.10 marks per ton before the war. In the mining industry, where the social burdens are heaviest, the social burdens amount to 600 marks per man per year.

Against this burden there is some complaint among industrial managers and a feeling that the workers have demanded too much. However, it would appear that these complaints are surface indications only, an evidence that the load is chaffing, but not that, if the issue were raised, they would fight hard for the removal of the burden. This statement is made because wherever one goes he finds much free-will welfare work. This work is carried on, without doubt, because it is good business policy to hold the good will of the worker. For example, in the I. G., quoted above, the free-will social work cost 21,000,000 marks last year, not quite twice the compulsory payments. One shrewd observer, commenting on the attitude of some industrial leaders and admitting that the burdens were heavy, suggested that it were better for industry to bear the burdens than to take the risk of communism.

GERMANY with her large population and her highly developed industrialism cannot consume all she can manufacture. But everywhere in foreign trade she strikes high tariff walls. This barrier is all the more serious, because Germany has a large foreign debt which she can pay only by having an export balance. The unfavorable balance had been decreasing during recent years. In fact, by making a special selection of an annual period, namely, the year closing Oct. 31, 1926, an export balance of 176 millions is found. Recently the adverse balance has sharply risen, due to rapid increase in importation of raw materials caused by the internal trade boom. In the first four months of this year the adverse balance was 1,174 million marks. Obviously, an export balance can be created by working in two directions, by decreasing imports and increasing exports. To work in both directions is the general policy of Germany's banking, commercial and industrial interests. Some of the steps being taken in these directions are noted later in this article.

As a result of the conditions recited the whole complexion of business in Germany is such as to discourage the stoutest hearts. Many companies have had to pass their dividends recently. Yet in the situation are favorable factors. One of these is the curtailment of speculation through the action three months ago of the Reichsbank, when it discouraged loans for stock exchange purposes. This should result in the diversion of money into investment channels. Another favorable factor is the courageous attitude, broad vision and hard work of the leaders.

Still another favorable factor is a labor cost relatively low compared with that of other countries, but coupled here with diligence and high intelligence. The skilled workers get from 0.85 to 1 mark per hour, depending upon the industry and district. Even at this wage there is complaint among industrial managers that the worker is demanding too much. Labor is said to be in the saddle. The official wage arbitrators are claimed to have a political bias and, uniformly, to favor labor. Evidence on these points, however, is conflicting. In defense of the worker, it is claimed that the wage purchasing power today is below that of pre-war times. In other words, the laborer is defended in his demands because it is believed that he is bearing a fair share of the burden through reduced standard of living. What wage increases he has received are claimed to be only equitable. Index figures, taking 1913 as a basis, show that wages have risen 160 per cent and the cost of living 146 per cent. But the figures do not seem to agree with the facts. Testimony is universal among the workers that they are not as well off now as before the war.

Again the worker is defended because of the spirit he has shown in accepting the desirability of industrial rationalization, which, for a time, will put a heavier burden, through unemployment on the working classes. Nevertheless, the worker agrees to the rationalization idea as essential for the economic rebuilding of Germany. Further, even the employers testify that the works' councils established by law in every factory, have, in general, ceased to be radical and political and are a help rather than a hindrance.

WHAT, now, of the future? Although not formulated in one place, there is a definite program in hand in Germany that deserves recognition and study. The crux of the situation is the need for export trade and an export trade balance. For the first, Germany must make goods that other countries either cannot or do not make, or do not make of equal quality, or, for equal quality, she must make goods cheaper. Other countries must need some German products so badly that they will take the goods over their own tariff walls; and, in turn, Germany must manufacture other goods so well and cheaply that the goods can leap the barriers. Second, imports must be reduced, relatively at least; Germany must produce and manufacture as much as she possibly can at home.

CHEMICAL industry shows striking examples in the matter of becoming more nearly self-supporting. Germany is now independent of Chile for saltpeter. In fact, she is exporting nitrogen fertilizer made from the air. It is expected that the production of nitrogen this year will reach 600,000 tons, of which 90 per cent will be synthetic. This is of immense importance to Germany. It cuts down imports (of Chile saltpeter), it gives a new commodity for export, and it offers the German farmer, through cheap fertilizer, a means of increasing crops, thus again cutting down imports (of foodstuffs). Incidentally, Germany is now exporting complete fertilizers (containing nitrogen, phosphoric acid and potash) of very high concentration—64 per cent actual plant food. These are expected to have a large market in competition with the usual fertilizers of lower analysis. The nitrogen and potash are secured in Germany and rumor has it that an electric-furnace process just going into production will permit the use of Germany's low-grade phosphorous supplies. A second marvelous chemical development is the liquefaction of coal by the

Bergius process. This produces motor spirit, lubricating oil and other products. A large plant which will use lignite and not bituminous coal is now being built by the I.G. on the economic ground of being able to undersell gasoline made from petroleum.

Going along side by side with the type of efforts described there is a drive for cost reduction in industry that is intense and inspiring. It constitutes a friendly challenge to the scientific and engineering genius of other lands. Heading all cost reduction efforts is the solid German front of scientific and industrial research which has been renowned for more than a generation. Its intensity and breadth have been increased under the economic urge pressing on the country. To be noted especially is the attention being given to what might be called research in pure science—the effort to explore new areas and to conquer new realms in the domain of science. Mr. Hoover has repeatedly emphasized the need for such research, in addition to research directed at immediate practical ends. Here in Germany research in pure science is in full blossom, not only in university laboratories, but within factory walls. For example, in one chemical plant I visited, employing 15,000 men, there are 300 people in the laboratory, and of these, 100 are engaged in research in pure science. These 100 have no concern with the technical problems of the plant, nor necessarily with new products. Their duty is to explore and to push out far beyond the practicalities of the day. It is for the management to have faith that some day and in some way the bread thus cast upon the waters will come back.

Cartels. In addition to the efforts at cost reduction, with all of which we in America are familiar, and in which (except possibly in research) the Germans acknowledge our leadership, the Germans have a device of their own for reducing cost and stabilizing industry. That device is the cartel, which, in essence, is some type of co-operation, chiefly in selling, price agreement and in allotment of production quotas, between manufacturers who are financially independent. The device is legal in Germany. It extends beyond German boundaries, and there are now a goodly number of international cartels.

On the whole, however, the cartel is not regarded as the cure-all of industrial difficulties that we, looking on from a distance, might be likely to regard it. As a means of meeting a temporary situation it is regarded as admirable. Such situations arrive most frequently out of great over-capacity and consequent ruinous price cutting. The cartel agreement in such cases allots production, and often fixes prices. The selling is frequently done through a central office.

In general, all the producers in a given line will not come into the cartel, and the competitors who stay out are claimed to keep the cartel prices reasonable. In some cases, right after the war, the government forced producers in certain industries to form a cartel or join an existing one. These compulsory cartels, though, proved unsatisfactory, and all of them, except the coal and potash syndicates, have been dissolved. One obvious danger confronting any cartel is that the low-cost producer will withdraw. While, in the cartel, he has the advantage of a price fixed with reference to the costs of the high-cost producer, but his quota may be unsatisfactorily low. Unless he can force a higher quota from his fellow members, his interests may be served by withdrawing and, with his lower prices, getting a larger share of the business and loading up his plant. This possibility is further cited by German business men as a protection to the public from possible cartel extortion.

Further, a cartel law was passed in 1924, setting up among other things, a cartel court, to which a member of a cartel may take his grievances and get relief from unwarranted actions of the cartel by securing release from his cartel agreement. The public may also use the cartel court as a means of stopping extortionate prices. Business men insist, though, that appeal to the court for protection of the public is not needed, since competition serves as an adequate regulator. On this point, there is disagreement, and one hears expression that the German government is in the power of big business. By these people the cartel law is cited as an evidence of the distrust of the public of the regulating power of competition.

ASKED whether the international cartel was designed chiefly as a means of effective competition with America, German business men just laughed. They maintained that European international cartels will reduce competition instead of increasing it, by eliminating below-cost competition. As a matter of fact, after the raw steel cartel was formed the price of billets rose five dollars per ton.

Indeed the Germans declare that we are the people to be feared as below-cost competitors, dumping on the foreign market. With a huge domestic market and, say, 10 per cent of the production of a commodity going abroad, we can afford to sell that 10 per cent, so they argue, far below cost just to load up our factories. Meanwhile the protection of our tariff barriers enables our manufacturers to get a good price at home. The cartel, it is pointed out, has one great danger, namely, its encouragement of technical stagnation. If the price protection should prove successful over a long period, there would be a tendency to neglect technical research and development.

We are, of course, trying to effect without the mechanism of agreement the main purposes of the cartel. We collect figures on production, stocks and shipments, so that when overproduction is threatened each manufacturer will see the wisdom of slowing down. The same figures discourage the increase of capacity by new construction when the market does not warrant it. Moreover, by encouraging sound accounting practice we hope to get all manufacturers to sell their goods at a reasonable profit. Our mechanisms are slower than those of the Germans, but we hope that eventually they may be reasonably effective in stabilizing industry. Already they have been invaluable.

Looked at fundamentally, it is my feeling, after hearing the discussions at Geneva, and talking to people here, that American industry need not fear the competition of German or international groups, merely because they are united in a cartel. There is no wonder-working mechanism in the cartel idea itself. It does not lower production cost, it does not lower selling costs if the selling be modern and aggressive. Therefore if we are "on our toes" technically, if we constantly lower our production costs, we will be able to compete. The crux of the situation is production economy—for us as well as for those joined in a cartel. If we will hammer this home to each other, if we "tend to our knitting" as it were, we need not worry about cartel movements in Europe, although of course we will want to learn what is going on. We must know what new and good economic mechanisms may be developing. Further, our strongest competition

will come not from financially independent manufacturers united in a cartel, but from large consolidated companies. These are the ones that can make sharp production economies.

This, though, must be borne in mind: Back of our tariff walls we can do whatever we wish as to price levels. If we want to run on a high level that is solely our concern. When we go into a foreign market, however, our goods, value for value, must meet a world price. Price at home and price abroad may be quite different things. Our goods, value considered, must sell lower than German and British and other foreign-made articles. Therefore, we must continue to produce cheaply *from the world standpoint,* while continuing our high wage level.

IN ADDITION to establishing foreign relations through international cartels the Germans are establishing good relations with the British that should lead to a better understanding of each other commercially. Last October the British Minister of Transport, Colonel Ashley, invited a group of German industrial leaders to meet a similar group of British industrialists at his home in Broadlands. In June the Germans reciprocated, with Dr. Carl Duisberg, chairman of the board of directors of the I.G. as host at Leverkusen. The meetings were small, the number at Leverkusen being twenty-eight. The meetings furnished opportunity for full informal discussion of the business conditions in, and relations between, the two countries. The situation in the iron and steel and the textile industries, the conclusions of the International Economic Conference at Geneva, the proposal for an international court for handling claims arising out of contracts between the nationals of different countries, the relation of agricultural to industrial conditions were some of the subjects discussed. One tangible result was the decision to interchange students in order to promote the business and cultural relations between the two countries.

One dominant impression made on the visitor in Germany is the spirit of open-mindedness among industrialists. Anything new interests them. They want to learn and adopt the best practice in every field. Incidentally, a plea for open-mindedness was the strong note of the address on behalf of the German delegation at the Geneva Economic Conference by Dr. Karl F. Von Siemens, head of the Siemens-Schuckert works. This attitude, too, is reflected in plant policy. If a more efficient machine is available and the money can be found the old one goes out. This policy is not so well applied here as with us, but when capital is available there will be rapid renewal of plant equipment.

With this open-mindedness goes great adaptability. One marvels for example at the turnover of large parts of the great Krupp plant from war to peace products. We, of course, made such conversions, but we look on Europe as more conservative, and do not expect such ready adaptability. This adaptability is further shown by the many ways in which the Germans are trying to change their methods and point of view and their whole industrial direction to fit the new conditions resulting from the war. These are the efforts that are being made to rehabilitate Germany industrially.

SUCH PLANS and efforts require the leadership of men of large capacity; and in them Germany is not lacking. One is constantly inspired by the men he meets here, manufacturers, merchants, bankers—men of deep knowledge of world conditions and of the technique of commerce and industry, men of vision and courage, men who work unceasingly, plan intelligently and think clearly. There is truly here what the Germans call a "begeisterung," a lifting up, an exaltation of the spirit. That it will produce still greater leaders of world trade no one who stays here for a few weeks can doubt. The strength of the German leaders was indicated at the International Economic Conference. The leaders there of the German Delegation—Dr. Karl F. Von Siemens and Clemens Lammers—stood out strongly.

Evidently the Germans are being forced to work as have been no people of modern times. Work, whether mental or physical, develops strength. One may well ask, as a very shrewd German suggested to me, whether the Germans might not be forced to become too strong commercially for the best interests of other industrial nations. Some day the handicaps will be removed; then Germany's competition may be overpowering. At least it will tax the genius of the rest of the world. History records the story of many nations that have come to greatness through the qualities developed during adversity; so, too, does it chronicle the tale of those that have decayed through ease and luxury.

SO, IN SUMMARY, the answers I would hazard regarding the situation in Germany and her future are these: Germany has made tremendous progress industrially, and against heavy handicaps. She is, however, hampered by conditions that make further progress difficult and slow. She is putting forth great effort; and it is making her industrially strong. Eventually, she will play an important part in the world's commercial affairs. She is adaptable and fits herself perfectly into the conditions and requirements of modern industrialism in all that term implies.

For us in the United States the lesson would seem to be this: Just now the competition of Germany will not have serious concern for the American people at large; but as our need for foreign markets grows and Germany's handicaps are reduced, German competition will be of deep concern to us. Let it not be looked forward to as commercial or industrial warfare. It is but the competition that we, as Americans, expect among ourselves; to the most intelligent, the most efficient, shall go the reward. So too in the future competition in foreign trade. Germany will be a worthy rival; the tools of competition will be the research laboratory, studies in waste reduction, researches to discover new methods and new products, and, finally, hard and intelligent work. We are stimulating Germany now to high endeavor in engineering enterprise and industrial management. She will, in turn, stimulate us. Our future position as against Germany will depend on our technical ability and commercial alertness in the development of industry and trade.

Probably I can do no better than to conclude with the observation made to me by that able German, Dr. Carl Duisberg, head of the great I.G. "America," he said, "can undoubtedly keep the economic leadership of the world for twenty or thirty years if her young people are taught to work." (I took him to mean that in that period Germany would be in a position to challenge our leadership, although this he did not say).

In Doctor Duisberg's emphasis upon work is the deep secret of Germany's potential strength in industry. For hard work there is no substitute; and that lesson the Germans have learned.

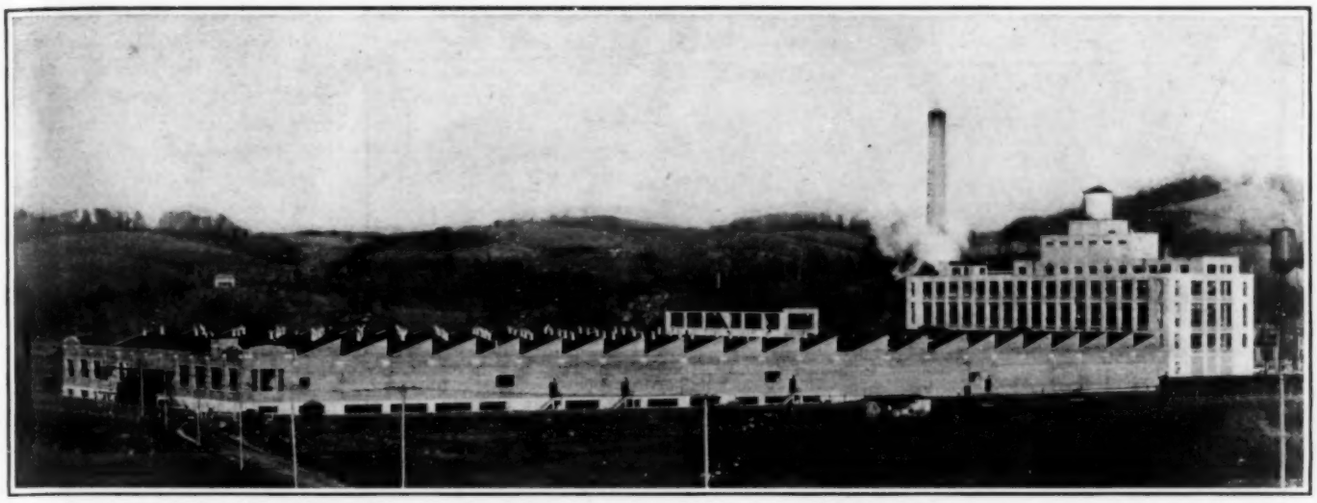


Fig. 1—New Rayon Plant of the American Bemberg Corporation located at Elizabethton, Tennessee.

Favorable Manufacturing Conditions For Producing Rayon

By Sidney D. Kirkpatrick
Associate Editor, Chem. & Met.

TWO vital considerations involved in any successful industrial enterprise are the selection of the proper plant site and the development of an efficient manufacturing unit that can capitalize, to the fullest extent, on the natural advantages accruing from such a location. In most of the chemical engineering industries there must be a careful balancing of many economic and technical factors of plant location. Furthermore, given a successful process that has already been developed to the stage of efficient production, there remains an important problem in designing and building the plant best adapted to take advantage of favorable manufacturing conditions.

An unusual opportunity to observe the practical solution of these problems in plant location and construction is afforded by the new rayon plant of the American Bemberg Corporation, which has been in operation since October, 1926. Testifying to the soundness of the decision to locate in eastern Tennessee is the recent announcement of plans for doubling the scale of operation at the Bemberg plant and for the establishment in the same locality of a second plant in which glanzstoff rayon is to be made by the American subsidiary of the Vereinigte-Glanzstoff Fabriken, A.G., Elberfeld, Germany. What, then, are the factors that make Happy Valley, Tennessee such an apparently happy solution for the plant location problems of the rayon industry?

S. B. Lincoln, engineer of Lockwood, Greene & Company, Inc., the firm that designed the buildings and laid out the machinery and process equipment in the Bemberg plant, lists eight major requirements for the location of a rayon plant: (1) labor, (2) water supply, (3) waste disposal, (4) fuel, (5) topography of site, (6) sources of raw material, (7) market for finished goods and (8) favorable local conditions such as taxes and railroad and highway facilities. A measure of the relative importance of these factors may be gaged from an approximate distribution of production costs by the viscose process. Mr. Lincoln, after studying figures given by various authorities on this subject believes the proper division of costs to be about as follows: Direct labor 48 per cent, raw material 26 per cent, light, heat, power and water 9 per cent, taxes, insurance and depreciation 8 per cent, supplies and repairs 5 per cent and administration 4 per cent.

HAPPY Valley, Tennessee, lies along the Watauga River in the northeast corner of the state. As shown in the accompanying map this area is one of general interest to chemical industry because of the variety of its mineral and forest resources, hydroelectric power developments and transportation facilities. Johnson City, the approximate center of the area, is on the main line of the Southern Railroad, 235 miles from Chattanooga and about 500 miles from Washington, D. C. In addition it is served by the Clinchfield Railroad bringing it within less than 100 miles of the famous Clinchfield coal region of eastern Kentucky and providing connection to the north and west. Johnson City is likewise the terminus of the East Tennessee and Western North Carolina Railroad, a short narrow gage line that serves this region. At an altitude of 1,700 ft. and with an average temperature in summer of 72 deg. and of 39 deg. in winter, the Johnson City area has attractive climatic conditions. The district is favorably situated as regards labor, raw materials, and fuel for light, heat and power—important factors in rayon manufacture since together they account

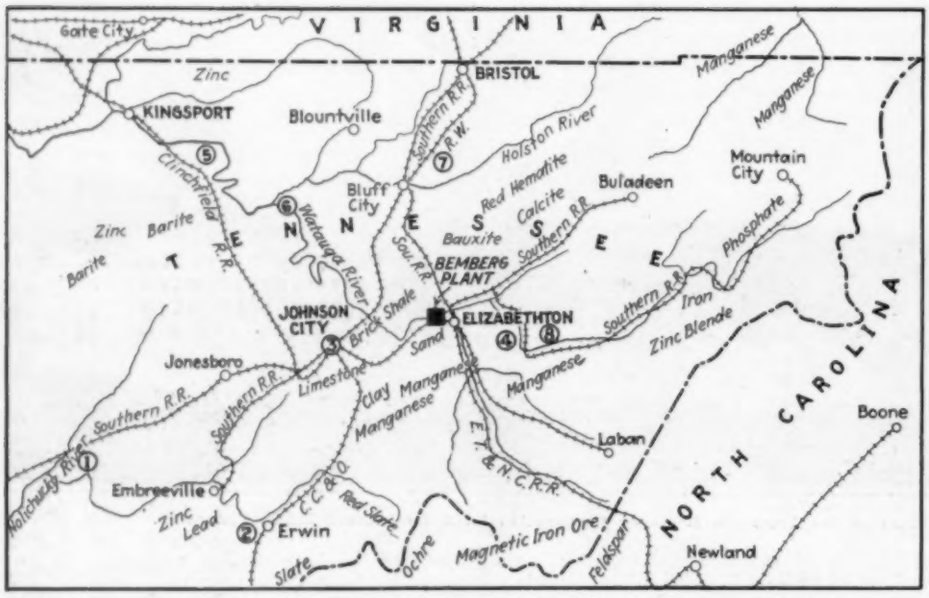


Fig. 2—Map of the Johnson City area showing Railroads, Mineral Resources, Rivers and Hydro-electric Power Developments.

1. Hydro-electric development of Tennessee Eastern Electric Company.
2. Privately owned hydro-electric development.
3. Steam auxiliary plant for Johnson City owned by Tennessee Eastern Electric Company.
4. Hydro-electric development of Watauga Power Company.
5, 6 and 7. Projected hydro-electric deevlopment of Holston Power Company.
8. Hydro-electric developments of Watauga Power Company now under construction.

for over 80 per cent of the total cost of production. A predominating proportion of the workers are native born and once trained to factory employment they prove thrifty and industrious. The supply is largely drawn from the surrounding country, in which, according to the census, but one person in every thirty-seven is now employed in industry. For that reason the rayon producers have not found it necessary to build their own industrial villages—an important consideration in an industry that must make large investments in its production facilities. At present approximately 1,500 people are employed at the Bemberg plant.

The new Bemberg plant is on a 1,000 acre site lying between the Watauga River and the E. T. and W.N.C. R.R. about a mile from Elizabethton. The principal raw materials from the standpoint of bulk are coal, cotton linters, water and the various chemicals used in the production process. The proximity to the cotton-seed oil mills of the South insures a convenient source of cotton linters. Water of good quality is obtained from the Watauga River and is purified for use in the company's own filter plant, which has a capacity of 3,000,000 gal. per 24 hours. The chemicals used in making up the cupra-ammonium solution and for other process uses are shipped from the north but since efficient recovering facilities are provided for conserving both the copper and ammonia, the plant is not penalized by excessive freight charges on these materials.

This plant was the first to apply the cupra-ammonium process by the Bemberg method successfully on a large commercial scale in the United States. The technical details of this process will not be discussed in the present article for this technology has already been treated at length (see "Making Artificial Silk by Cupra-Ammonium Process," by L. S. Fryer, *Chem. & Met. Eng.*, Vol. 30, No. 19, pages 743-8 (1924) and "The Cupra-Ammonium Process" Chap. XII, The Rayon Industry, by M. H. Avram, New York (1927). It is desirable, however, to outline the principal steps of the process in order to show certain outstanding features of building construction and equipment that have contributed to the favorable progress of the Bemberg plant.

The first four steps of the process, viz., purification of the cotton linters, bleaching, dissolving in the cupra-ammonium solution and the processing of the resulting liquid are all carried out in the 5-story reinforced concrete building shown in the background of Fig. 1. Construction here is not essentially different from that employed in modern chemical plants. Reinforced concrete has been used throughout because of the heavy floor loads and the wet processes that involve steam and corrosive vapors. The floors are of acid-resistant construction with special drainage in order to make it possible to recover valuable process materials that might otherwise be lost through spillage. Lead-lined pipe and equipment are used in handling the copper sulphate solution from which the copper hydroxide is prepared. Plate and frame filter presses equipped with special screens are used in filtering the precipitated copper and in the final clarification of the cupra-ammonium solution. This solution is made in mixers of special construction into which have been added the quantities of the various materials necessary in order to give a solution of the desired viscosity. Before it is ready for spinning, however, it is necessary that the clarified and filtered solution be further processed in equipment provided with ingenious means for the automatic control of temperature and pressure.

Spinning, which might be called the first of the textile operations, is carried on in the large room directly adjoining the chemical building. Roof spans 80 ft. wide were necessary in the construction of this department. A feature of the spinning process that is peculiar to the Bemberg product is the so-called "stretch spinning" method. As the cupra-ammonium solution is forced by pressure through the tiny openings in the spinnerettes,

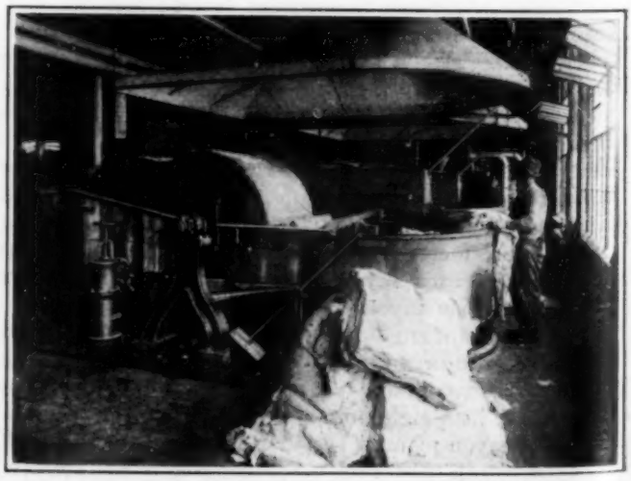


Fig. 3—One of the First Steps in Rayon Manufacture—Purifying the Cotton Linters That Serve as Cellulosic Raw Material.

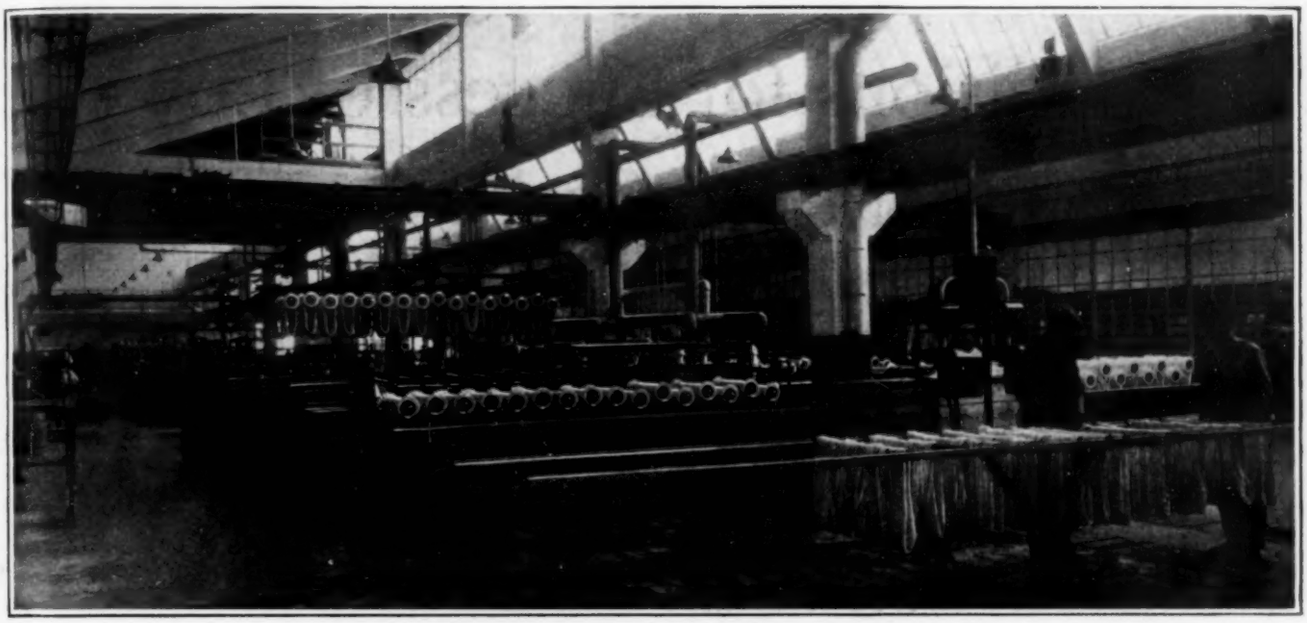


Fig. 4—Washing Room in the Bemberg Plant.

Yarn from the spinning room is slowly turned in the washing bath on the porcelain spools until completely washed. It is then picked up by the traveling crane and carried to the dripping rack shown in the foreground.

the filaments, while partially hardened in the coagulating bath, are drawn and stretched to the required fineness. This makes it possible to spin a single filament of the same size as real silk, thus 150 denier Bemberg yarn consists of 112 separate filaments.

Washing the yarn to remove the copper and coagulant is the next manufacturing operation. The washing room in which this is accomplished (See Fig. 4) is of special construction necessary in order to prevent condensation of vapors and consequent dripping from the roof. Two inches of cork insulation are used beneath the roof of the entire washing department. Hollow-brick side walls and double glazed windows (with air-space between) are provided for the same reason. It will also be observed from Fig. 1, that there are no window openings in the saw-tooth portion of the plant. This was done in order to prevent direct entry of sunlight and for the same reason all of the skylights face the north. It will also be noted from Fig. 4 that all concrete construction was used in the washing department since the wooden roof plank used elsewhere in the saw-toothed building might be rotted in time by the steam and vapors arising from the washing baths.

The steam dryers of Proctor and Schwartz manufacture, such as are shown in Fig. 5, are of standard construction and operation. From these dryers the skeins are conditioned by storage under controlled conditions of humidity. The skeins are then taken to the textile department and the yarn is spooled, twisted, reeled, sorted and packed in accordance with the usual succession of these purely textile operations.

One of the most important features of the Bemberg plant is the unusual attention given to air conditioning and special ventilating equipment. A central station type of humidifying and cooling equipment is used with provision for recirculation of the heated air during the winter season. The fan room in which the air conditioning equipment is housed is located directly above the main structure of the factory building. The Carrier Engineering Corporation of New York laid out and installed the air-conditioning equipment including controls for the textile department, washing room and spinning room. The air conditioning for the chemical building was installed by the Cooling and Air Conditioning Company of New York.

The Bemberg power plant is unusually large not only because of the large amount of process steam required but also to provide for the extension of the present manufacturing facilities. Power is needed only for pumping water, circulation of liquids, air compression and operation of the textile machinery and the air conditioning equipment. The present plant has three 400 hp. Springfield boilers with two 750-kw. General Electric turbines that run non-condensing.

As mentioned in the introduction of this article, Lockwood, Greene and Company, Inc., were the engineers in charge of the design and construction of the plant and under the direction of Max Korff, vice-president and technical director of the American Bemberg Corporation, purchased and installed the American made process equipment. For the privilege of inspecting the plant the writer is indebted to Dr. Arthur Mothwurf, president of the American Bemberg Corporation and to Robert J. H. Worcester, chief engineer, who with Harold Hunter served as resident engineers for Lockwood, Greene & Company, during construction of the Bemberg plant.

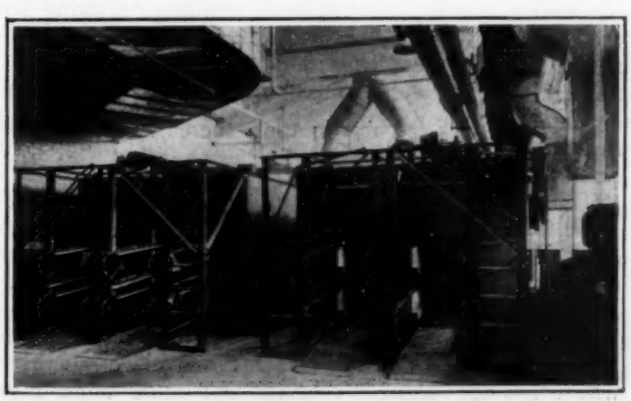


Fig. 5—Dryers in Which the Washed Skeins are Dried.

Conditions for Success of Low-Temperature Carbonization

By William Everard Davies
Treorchy, Glamorganshire, Wales

IN 1922 at the Low Temperature Carbonization Conference, held at Cardiff and Swansea, the author stated that he did not believe carbonization carried out below 750 deg. C., to be practical. The process cannot compete with high temperature processes in throughput except at medium temperatures accompanied by a higher rate of heating. Finishing temperatures below 600 deg. C., endanger the quality of the product because of the plastic state at such temperatures and make the retort difficult to discharge unless specially designed. The value of the product is reduced by leaving volatile in excess of 4 to 5 per cent in the semi-coke.

Consequently, any really successful process must accomplish the following: 1. The heating rate must be such that it can compete in throughput with high-temperature processes; 2, it must yield liquid products which have a ready market, under control as to quality, quantity, and interchangeability with the gaseous yields; 3, the desired grades of raw coal must be available at low cost and there must be a convenient market for the disposal of the finished products at a profit; 4, it should be a process flexible as to raw materials that can be used, methods of operation and finished products produced; 5, the design, construction and operation must be simple.

> Whether low-temperature carbonization can or cannot compete with the methods of coal carbonization at present in use is not only a technical question but is also a difficult engineering and commercial problem.

The rate of heating is dependent upon several factors among which may be included the following: Flue temperatures, oven wall material and oven wall thickness, the character and plastic behavior of the coal used; the amount of distilled gases passing outward against the retort walls, and through the heated coke dependent upon the path of travel factors, the presence or absence of central offtake, the usage of blending or sizing for the control of the plastic state, the design of the flues and the rate of heat transmission through retort walls, the method of heat transmission used, external, internal or combined, the rate of heat penetration accompanying the rate of rise of temperature and the method of generating the heat in the flues.

The employment of high heating rates is desirable because it secures high throughput and good quality semi-coke. Such heating has a beneficial effect on the coke structure and reactivity. It results in a stronger coke.

The continuous vertical type of retort is the most useful apparatus for this purpose. It is probable that this form of plant alone will withstand the severe competition which low-temperature systems will meet from high temperature gas and coke works. The superiority of the product produced by avoiding the very high and protracted heat of high-temperature carbonization is a great point in favor of the medium temperature process.

The question of the limiting point below which the high temperature process will be able to hold its own will solely depend upon the critical throughput necessary to give effect to the general cheapening of the carbonization process by intensification of the heating rate. At 100 per cent increase in throughput the Fuel Research Board is dubious as to whether there is any net saving as regards the application of their Glover-West retort operated along smokeless fuel lines. However, it seems evident that granted the same yields obtained by the Fuel Research Board for 100 per cent increase, it will be readily possible by further heat increases to realize a very appreciable economy in gas work practice by this one factor alone. If a 400 or 600 per cent addition in throughput is obtained as was done by the writer at an experimental plant at Staines, then the question of reducing the cost of gas making is solved.

In ordinary practice the tars are invariably the result of secondary decomposition carried out upon the primary tars within the plastic zone, in the outward stream in the coke zone, and at the top of the oven in the free space under the crown. In medium temperature carbonization the tars are of a more primary character, comprising a higher proportion of aliphatic bodies, more especially when the offtake is completely central, which enables the tars to escape from their point of origin in a condition approximating that of their liberation.

It is possible to modify and improve the gaseous yields at the expense of the coke by steaming the charge so as to give an improved yield of distillate. This operation cannot be considered here in detail, but it may be pointed out that the primary tars may be considerably altered by cracking, passing them through the retort a second time, and also by influencing the gaseous atmosphere by steam injected into the retort alongside of the tars. In this way the optimum yield of medium temperature primary or secondary tars may be obtained with complete control.

It is not proposed to suggest that the low-temperature carbonization industry cannot be made to yield more to the consumer, that is to say, that the solid fuel cannot be supplied at a lower cost than raw coal cost is competitively supplied. But it must be remembered that probably future competition between the raw and pre-

Table I—Low Temperature Balance Sheet (Coalite Process) Issued in November, 1925, by Low Temperature Carbonization, Ltd.

Products	Coalite Quantity	Coalite Value	Gas Works (Mr. D. M. Watson) Quantity	Gas Works (Mr. D. M. Watson) Value
Gas at 4d. per Therm.....	39.6 Therms	13.2s	72 Therms	24.00s
Tar and oils at 4d. per gal..	18.62 gal.	6.2	10 gal.	3.33
Ammonia at 3s. 6d. per butt	0.24 butt	0.84	0.28 butt.	0.98
Motor fuel at 1s. per gal....	1.78 gal.	1.78	.....	.....
Coke at 32s. per ton(av.pr.)	13.23 cwt.	21.16	13.00 cwt.	20.80
Breeze at 10s. per ton.....	0.69 cwt.	0.34	1.00 cwt.	0.50
Gross products.....		43.52		49.61
Less cost of fuel for heating retort gas.....		1.66	3.00 cwt. coke	4.80
Less cost of coal per ton.....		15.00		30.00
Balance for profit and working charges.....		26.86		14.81

pared fuels will more than likely result in a dual form of price reduction. It is advisable, therefore, to take the price of the two as equal, evaluating the balance sheet for variable amounts in the price of each kind of fuel. The advantages to the consumer, therefore, will be largely those of convenience and avoidance of the smoke nuisance together with those of an indirect nature such as cheaper liquid and gaseous products.

It will be observed from Table I, that the cost of coal in gas works practice is quite what it is assumed to be for low-temperature carbonization. Therefore, the comparison is only applicable to the different conditions obtaining between the two processes and does not give any proof of financial disadvantage one way or the other in direct competition. It is useful, however, in so far as the table is based upon working plant results. The value placed upon the gas yield obtained from the low-temperature process is given as the equivalent of gas works practice (cost at holder), whereas in competition from a private sale to a gas company three pence to two pence per therm would be more likely to be the actual realization. Offsetting this, however, the price of tar from the low-temperature process is in its favor, since five to sixpence can be generally obtained and often times high-temperature tar cannot bring over three pence per gallon. Likewise the price of motor fuel may often reach one shilling per gallon.

As against the above table, Table II gives a fair comparison between the ordinary gas works practice and the medium carbonization process proposed above. In Table II allowance has been made for the operation of both processes at the gas works, coal costing £1 and 30s. per ton respectively. From 15 to 20 therms per ton could be left over in the residual coke as volatiles for giving it a free burning character. Accordingly, some 50 to 55 therms of the gas yields in Table II are derived from the distillation of volatiles, whereas 15 to 20 therms are due to the steaming operation. The proposition, it will be seen, is placed upon an entirely different footing if and once the yield of gas is equal to that of present gas works practice, since the gas yield is the principal revenue earning factor.

The quantity of raw fuel used is to be taken as equal

Table II—Medium Temperature Balance Sheet. Comparison of Proposed System with Ordinary Gasworks Practice

Products	Proposed System 700 to 900 Deg. C. (Steaming) Quantity	Proposed System 700 to 900 Deg. C. (Steaming) Value	Present Gas Works Practice (From D. M. Watson) Quantity	Present Gas Works Practice (From D. M. Watson) Value
Gas at 4d. per Therm.....	70 Therms	23s. 4d.	72 Therms	24 s.
Tar and oils at 4d. per gal..	20 gal.	6s. 8d.	10 gal.	3s. 4d.
Ammonia at 3s. 6d. butt...	0.3 butt	1s. 2d.	0.28 butt	1s.
Motor fuel 6d. gal.....	2 gal.	1s. 0d.	.....	.....
Coke at 32s. per ton (av.pr.)	14 cwt.	22s. 5d.	13 cwt.	20s. 8d.
Breeze at 10s. per ton.....	.....	.....	1 cwt.	6d.
Gross products.....		54s. 7d.		49s. 6d.
Less cost of fuel for retort heating.....	1½ cwt. coke	2s. 5d.	3 cwt. coke	4s. 10d
Less cost of coal per ton....	.....	20s. 0d.		30s. 0d.
Balance for profit and working charges.....		32s. 2d.		14s. 8d.

in both cases and as being of the highest grade: That is, a coal of about 14,000 B.t.u. per lb., 40 to 33 per cent volatile content or superior. Such coal, it is assumed, is capable of yielding 14½ cwt. of coke in the coke oven and of not exceeding 5 per cent ash with moisture not over 3 per cent.

From the tables it will be apparent that the governing factors in each case are respectively, the cost of coal and the equality of gas yield. In the second case there is also an appreciable margin of advantage in coal in favor of the medium temperature process. These fundamental considerations apart there is nothing in the balance sheet outside the rudiments of simple arithmetic and the results of either process would be determined solely by the unequivocal issue of which process is to be adopted.

Table III shows the balance between the low-temperature semicoke and the price of coal.

From Tables I and II it is apparent, however, that this condition is only necessary when the solid fuel is the primary yield and the prime source of revenue. Such a condition is, therefore, of much greater effect and would influence the results more under colliery conditions than gasworks conditions, where the prime factor is the gas yield.

It appears that the real opportunity for such processes lies at gas works, which can readily adopt the process as their general working process where a good

Table III—Balance of Coal Cost Against Coalite Revenue

Cost of Coal Plus Handling, Preparing and Transport Charges Shillings	Selling Price of Coalite (70 per Cent Basis) Shillings	Pence
10	14	3½
15	21	5
20	28	7
25	35	8½
30	42	10½
35	50	0
40	57	2

Note: Price of coal in London, Nov. 1925, 45s. per ton.

quality of coke is required, or with combined colliery and gas producing schemes, or combined colliery and power producing schemes where a ready outlet for the gas is available. Let it not be understood that the author proposes to scrap present gas works processes, especially as such plants are not excluded from forming part of the equipment in conjunction with these partial carbonizing schemes. The proportion would in such cases be regulated by the amount of fuel for which there is a market. A combination of a partial carbonizing plant and the present gas works plant is therefore based solely on the negative answer which the writer considers is inevitable for some time to the question of the feasibility of making gas the sole fuel for all purposes. It is worth noting that the price of coke as domestic fuel at £2 per ton is only about two pence per therm, whereas the price of gas would be five or six times as much.

Works costs are reducible to two bases of computation: (a) The cost per ton of coal treated; and (b) the cost per therm of gas made. Note that the former basis should be used for comparing partial carbonizing systems outside of gas works practice, and the latter comparison should be used in gas works practice.

In respect to the cost per ton of coal carbonized, the partial carbonizing system will always compete with the complete carbonizing process operated with the same design of retort. But in respect to the cost per therm of gas made the complete carbonizing procedure will, when attended by partial or complete gasification of the coke, compete favorably with the partial carbonizing process, since for every coke therm gasified, the revenue is increased by two pence or more per therm.

Respecting details and concrete data, it will perhaps be best to take the published returns for the workings of the Gas, Light & Coke Co. of London for 1926-1925 and to place these alongside of the modifications devolving from the operations of a system yielding five, six or seven times the throughput of their report and yielding the same results in all other respects, as in Table IV.

From the above it is clear that labor is not the most important item under high-temperature carbonization practice, but that maintenance is. In the system proposed in this article, the maintenance is rated too high even at the figure derived after allowing for the throughput discount. A lower actual figure is assured since the super-refractories used stand up better than ordinary refractories, allowance for throughput being made. This is due to the ratio of throughput per £ expended upon refractories exceeding the multiplying factor of 4, 6 or 7 times as the case may be so that an added economy results due to the longer life occasioned with the super-refractory per ton of coal treated per £ expended upon refractories. As regards iron and steel work, naturally an increased throughput will inevitably reflect favorably on account of an almost pro rata reduced ground area and size of plant.

Table IV—Operation of Gas Light & Coke Co., London Compared to Theoretical Systems of 5, 6 and 7 Times the Throughput.

	Expenditures						
	1926		1925				
	Total	Per Therm Sold	Total	Per Therm Sold	5x	6x	7x
Coal, etc.	£5,054,064	5.39	£3,557,328	4.51	5.39	5.39	5.39
Salaries	120,846	.13	86,931	.11	.03	.02	.02
Wages	424,788	.45	383,317	.49	.09	.07	.06
Purification	50,321	.05	35,300	.04	.05	.05	.05
Maintenance	1,834,577	1.95	1,334,315	1.69	.40	.35	.30
Total		7.97		6.84	5.96	5.88	5.82
Difference					2.01	2.09	2.15

It may, therefore, safely be concluded that a very appreciable reduction is possible in the cost of manufacture of gas even along the lines of partial carbonization provided equal or about equal gaseous yields are obtained per ton of coal carbonized. Such a seemingly paradoxical proposal is only capable of realization providing a higher rate of throughput is practical and by compensating for the reduction of the gas therms involved by leaving residual volatiles behind in the solid fuel by steaming up to the point required to secure an equivalent thermal yield of gas.

It must not be concluded from the above that the proposed system is solely restricted to such a *modus operandi* as that is by no means the case. The main saving from an individual plant by a gas company is naturally only possible along the lines of complete gasification.

£200 per ton of coal carbonized per day has been given by P. C. Pope, as an essential limit of capital cost to which low-temperature plants must conform. The writer agrees that this figure is a fair high water line for systems such as the Coalite process, where the throughput per retort per day is not very high and the financial returns are limited by reason of a low yield of gas. Such a system is properly at home in a colliery scheme but is not generally adapted for the needs of the gas industry except as an outside feeder of a cheap gas supply. £200 to £250 per ton of coal carbonized per day is on the other hand not excessive where it is possible to enhance the commercial harvest of the system by catering to the combined demands of smokeless fuel, gas and liquid fuels. This figure is lower than that in vogue at present on high-temperature carbonizing systems, whereas the return is capable of being very considerably increased compared with that given by the present gas works and coking installations. It should be stated that this figure is amenable to appreciable reduction as the scale of the plant is enlarged. £175 per ton of coal carbonized per day may reasonably be reached on the larger scale installations. Both figures are rated on the guaranteed capacity of the plant, whereas Mr. Pope has assumed three hundred working days to his year under normal full load conditions. In the gas industry at present a capital cost of over £300 per ton carbonized per day is met with.

In previous high-temperature carbonization practice the yield of gas is obtained from the following contributions: 1, the permanent gases formed during the initial or primary decompositions of the original coal substances or the decomposition products over a temperature range of carbonization; 2, the product gases due to the cracking of the low-temperature tars in the plastic stage and during the outward travel of part of these tars, and at the oven top.

In accordance with the procedure herein proposed, item 2 above is almost entirely cancelled, but a larger yield is made up by steaming the charge. In this connection, the author's work has been amply confirmed by Mr. A. W. Warner of the Philadelphia Suburban Co., Chester, Pa., who in 1923, before the American Gas Association, gave the results of a study of some physical laws governing the carbonization of coal and coke. Warner states that in studying the basic physical and chemical laws governing the phenomena of carbonization, it would appear that a fourth distinct fundamental process from the existing coke oven, low-temperature carbonization and complete gasification processes is possible, whereby the low volatile, close grained coke of the coke oven may be retained, the 23 gal. of low-temperature and complete gasification oil may be obtained, also a yield of 8,000 cu.ft. of 700 B.t.u. gas. The gas yield, it would appear, may be obtained by adding to 4,000 cu.ft. of low-temperature gas, the gas from high-volatile coke of the low-temperature residue.

Warner further propounds five basic laws governing carbonization: 1, if removal of volatile matter from coking coal were the only consideration the high heats commonly used in carbonization are unnecessary; 2, the condensible hydrocarbons of coal are more valuable as raw products the nearer to their primary state they exist, because no way has been found to convert any but a meagre portion of them into permanent gas; 3, the less cracking and the more distillation of condensible hydrocarbons that occurs, the less will be the intensity of heat required to drive off the volatile matter of the coal; 4, the less the heat through which the gases from the nondensible hydrocarbons pass in leaving the retort, the richer will be the gases and the greater the heat output from this source per unit of coal; 5, the closer the conditions of 4 are met, the greater will be the possible cubic feet of mixed gas of a determined B.t.u. per unit of coal.

In an experiment designed to determine the contribution of item 2 above to the gas yield, Warner concludes as in Table V.

This result, 1,000 cu.ft. of 560 B.t.u. gas, tallies closely with conclusions of most investigators as to the contribution of tars to high-temperature gas yields. Therefore, obviously, states Warner, it is far from economical to ruin 83 lb. of low-temperature oils for 1,000 cu.ft. of 560 B.t.u. gas equivalent. There must be some way to save low-temperature oils and at the same time

drive off the rich volatile matter remaining in the coke.

As to Warner's experimental conditions and conclusions it is evident that he endeavored to probe by laboratory methods the underlying factors of fuel distillation and up to a large measure succeeded. In relation to the author's work, the conclusions he came to are both significant and approving since the author's systems are embodiments whereby all his conclusions may receive practical effect so far as working conditions allow. Warner's conclusions, however, stop short in some respects, merely because they did not propose to cover the same amount of ground, it should be explained, of the

Table V—Test to Determine Amount of Gas Obtained by Cracking Tar Oils

Sample roughly 10 gal.	=	83 lb.
18 lb. tar	=	22 per cent
32 lb. gas	=	38 per cent
33 lb. carbon, etc	=	40 per cent
83 lb.		100 per cent

or about 1,000 cu.ft. of 566 B.t.u. gas.

proposals which have been made in this paper and which the author has combined in his fuel distillation systems.

The first of Warner's laws is mainly of theoretical importance unless the fuel charged is in the form of fine particles. In mass carbonization a steep gradient is inevitable across the coking width. Accordingly higher heats must be used to compensate for this fact. The only condition in practice required to enforce the resultant effect of this law lies with that of central offtake.

The second law is true in the aggregate of the condensible hydrocarbons, but is subject to qualification if selective cracking of the tar compounds is given effect.

The third, fourth and fifth rules need no comment and afford the argument against present high-temperature retorting systems which employ a path of travel adverse to the conservation of the primary distillates.

The heat penetrating retort walls as used in high-temperature carbonization is usually proportioned as follows: Decomposition and distillation, 37½ per cent; heating gas and vapors, 26½ per cent; sensible heat of the coke, 36 per cent.

Warner studied the influence of distillation and cracking on the intensity of heat required and the final mode of existence of the product. A comparison of the carbonizing time with the same intensity of heat with and without cracking indicated how unnecessary are the high heats used, over 1,000 deg. C., in ordinary carbonization. In every test where excessive cracking is avoided, the time of carbonization was cut almost in half.

From Warner's work it transpires quite clearly that an appreciable difference obtains between the non-condensible and the condensible components of the low-temperature or primary tars. It may, however, be pointed out that in present high-temperature carbonization apparently the former alone suffer the incidence of high-temperature decomposition due to an outward path through the heated coke, and that the decomposition suffered by the latter at the oven top is limited in effect because of the lower temperatures obtaining there, and the sudden cooling due to the commingling of the inward bound gases with the hotter gases. The changes wrought in the inward stream demand great heat for yielding gas, and, accordingly, as a matter of fact, only modifications of the liquid components eventuate: Gas is, therefore, only obtained from the outward stream.

Professor Lews shows the influence of heat on the final gas about as follows: A ton of coal yielding 4,000 cu.ft. of gas under ordinary low-temperature carbonization (1,100 deg. F.) yields 10,000 cu.ft. of gas in high-temperature horizontal retorts (1,800 deg. F.). The residue after the low-temperature carbonization when heated to 1,800 deg. F., yields 4,500 cu.ft. of gas. We may assume the 10,000 cu.ft. of gas has been made up as shown in Table VI.

Warner's experiment proved it is uneconomical to drive off volatile from the coal at a temperature of 1,470 deg. F., and even lower and that the condensible tars can, at the same time, be driven off, away from the heat, at 750 deg. F., and lower. "Therefore, referring to the above example, it must be possible to obtain the full gas yield from the non-condensible hydrocarbons with far less degradation of the primary gas. There should be no gasified tar but in its place oil removed at low temperature for more suitable economic uses. An ethane content of 8 per cent is not unusual for gases evolved during the tests with a retort wall temperature of as high 1,470 deg. F. Such gas contains absolutely no trace of naphthalene."

In examining and interpreting the conclusions of Warner it is, however, imperative to bear in mind that the experiments were conducted with high rates of heating—appreciably higher than those of ordinary practices and that the early and ready release and removal of the volatiles is mainly dependent upon this factor.

The importance of Warner's work as a confirmatory survey of the author's proposals lies particularly in the practical use to which the fifth rule laid down by him may be put. It can be shown this way:

1. 4,000 cu.ft. at 1,000 plus 10,000 cu.ft. at 300 equals 14,000 cu.ft. at 500 B.t.u.
2. 8,000 cu.ft. at 700 plus 8,000 cu.ft. at 300 equal 16,000 cu.ft. at 500 B.t.u.

The first of these corresponds to the dilution of ordinary low-temperature carbonization gas with blue

Table VI—Make-up of 10,000 cu.ft. of Gas Distilled from 1 Ton of Coa in High-Temperature Horizontal Retorts

Primary gas	4,000 cu.ft.	40 per cent
Degradation (11 per cent)	440 cu.ft.	4.4 per cent
Residue in coke	4,500 cu.ft.	45 per cent
Gasified tar	1,060 cu.ft.	10.6 per cent

gas, and the second corresponds to the dilution of medium temperature complete carbonization gas with blue gas.

If, however, the blue gas is made by steaming the charge, a higher calorific value than 300, say up to 350 B.t.u., can be realized under the most favorable circumstances for the diluting gas.

While the condensible and, in fact, any heavy liquid compound of the primary tars cannot be made to yield gas of any value when cracked in the ordinary way, it is quite feasible when performing the operation in an atmosphere of nascent hydrogen, and, where steaming is in vogue, to considerably alter this state of affairs by a return tar injection. The heavier distillates can then be progressively worked up without carbon deposit and gradually improved in say two or three treatments. In a high rate process there is always enough waste heat available to promote such a tar cracking process without drawing excessively upon the thermal demands within the heating flues, since as a matter of necessity higher heats than desirable for loosening the volatiles are inevitable on heat transmission grounds.

The proposals made in this article, therefore, give in effect a harmonized system comprising the theoretical ideals of heat transmission alongside those of heat utilization.

Recovering Chemicals from Oilfield Brines

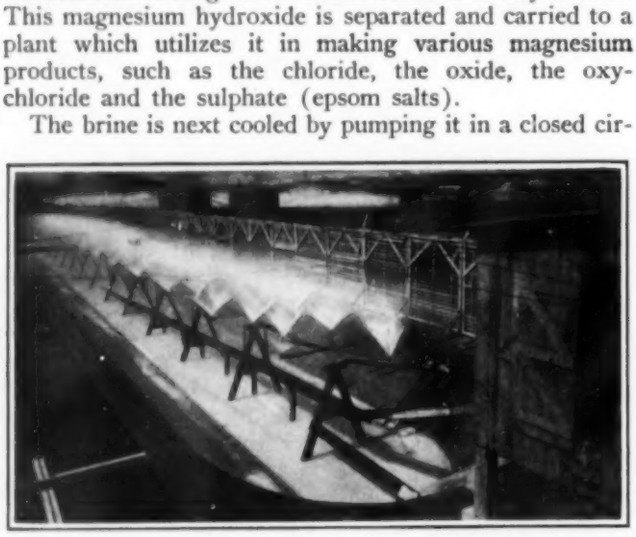
EDITOR'S NOTE—*Calcium chloride, salt, magnesium compounds, ammonia and bromine are now being recovered on a commercial scale from the so-called "salt water" often encountered in deep-well drilling for oil. Otto Martin, who conceived the idea of recovering these chemicals and designed the plant of the Sand Springs Chemical Company of Sand Springs, Oklahoma, describes his process in the following report made to Dr. Charles N. Gould, director of the Oklahoma Geological Survey.*

DEEP-WELL brine from the Wilcox oil sands of Oklahoma is the principal raw materials from which a variety of chemical products are now being recovered in the plant of the Sand Springs Chemical Company, at Sand Springs, Okla. As this brine comes from the oil fields, it is first treated with calcium hydroxide for the removal of iron oxide. The iron oxide so obtained is precipitated in a flocculent form and as such finds a ready market as a pigment.

The brine is then aërated for the production of ammonia. This ammonia is ordinarily scrubbed out with sulphuric acid for the production of ammonium sulphate. It can, of course, be converted into any ammonium salt desired.

Further treatment with calcium hydroxide results in the removal of magnesium in the form of the hydroxide. This magnesium hydroxide is separated and carried to a plant which utilizes it in making various magnesium products, such as the chloride, the oxide, the oxychloride and the sulphate (epsom salts).

The brine is next cooled by pumping it in a closed cir-



One of the Spray Ponds for the Evaporation of Oilfield Brines to Recover Calcium Chloride and Other Chemicals.

cuit with the power plant condensers and the spray pond shown in the accompanying photograph. The water is thus evaporated by cooling instead of by heating. The condenser in the power plant does nothing more than bring the temperature of the water back to slightly above the dew point; it is then cooled to approximately the dew point, resulting in the evaporation. It passes back to the condenser and is cooled again for further evaporation. With the addition of make-up brine this process continues indefinitely.

Because of the limited solubility of the sodium chloride and the maximum solubility of the calcium chloride, the sodium chloride is precipitated at this point. This salt is removed by mechanical means and carried to the department where it is washed, dried and prepared for shipment. Salt produced by this process is entirely free from sulphates, is light and fluffy and is a superior product for human consumption.

After the removal of the sodium chloride, the bromine is either removed as such or by treatment with wild casing-head gas the bromine is converted into ethelyne dibromide. This product has a ready market in the production of certain anti-knock compounds.

Following the removal of the iodine content, the remaining solution passes to the calcium-chloride plant where it is treated to produce the various forms of calcium chloride.

The preceding brief outline gives only the basic products produced. It would be useless to attempt to detail the various possibilities of chemical manufacture by the further combination of these basic products. It is of interest to observe, however, that the brines of Oklahoma should produce enough ammonia to fertilize the farms of the state and, further, that these same brines should produce enough ethelyne dibromide to supply the entire demand for this product.

The possibilities of the combination of the products of Oklahoma brines with waste petroleum products are very broad. For example, ethelyne dichloride might be made very cheaply from brine and waste refinery gases. This product may within the next ten years take the place of the hydraulic pressing process now used in extracting cotton-seed oil. It will further give a complete extraction and leave a satisfactory white meal.

Consumption of Sulphuric Acid in Oklahoma

A close estimate of the annual sulphuric-acid requirements of the oil refineries of Oklahoma, based on information obtained from the principal producer, is approximately 70,000 tons instead of the published figure of 200,000 tons quoted by Dr. Gould and Professor Shead in the July number of *Chem. & Met.* Practically all of this at present is being supplied by the contact-process plant near Tulsa which has an annual capacity of 45,000 tons and by a byproduct plant located just across the Oklahoma line in Kansas. The company owning the latter is now constructing another sulphuric acid plant to make use of the byproduct gas from a zinc smelter at Bartlesville. It is reported that this plant will have an annual capacity of approximately 35,000 tons.

Low Temperature Carbonization Plants Promised

In a recent statement to stockholders, George E. Learnard, president of the International Combustion Engineering Corporation forecast the construction by his company in the near future of two commercial-sized low temperature carbonization plants. This company has recently acquired the American rights to the German "K.S.G." process, which has been in successful operation at Essen, Germany, for some time. This process is claimed to yield a superior grade of smokeless semi-coke or char in addition to satisfactory yields of gas and tar. The corporation also owns the McEwen-Runge low-temperature process, which is now being tried out on a large scale as a power-plant auxiliary. These activities promise early information as to the possibilities of such processes in America.

Long Distance Transmission of Natural Gas

By William Moeller, Jr.
General Manager, Midway Gas Co., Los Angeles, Calif.

The Pacific Southwest depends almost entirely for domestic and industrial fuel on gas and oil. Practically all of the gas produced by the California oil fields is used thus, and the excess demand is in part supplied from the northern fields, over 100 miles away, through pipe lines.

THIS OUTLINE of the activities of the Midway Gas Co., which is the largest natural gas company in the Southwest, brings out the extent to which natural gas, produced in large quantities in conjunction with the production of crude oil, has been conserved and put to useful purposes for the benefit of the people in this district. The phenomenal industrial development of this district is due in a very large measure to the fact that the great production of natural gas was conserved and made available to serve a useful purpose, by the natural gas companies.

The Midway Gas Co. was organized in 1912 for the purpose of transporting natural gas from the Buena Vista Hills field to Los Angeles. The first pipe line was constructed in 1912-13, extending 111 miles from Taft to West Glendale (see Figs. 1, 2 and 3) and the first natural gas compressor plant was completed at Taft in 1913. Production of large quantities of natural gas in the Coyote Hills field, east of Los Angeles, in 1915, was responsible for the construction of a pipe line from this field to Los Angeles during the early part of 1916. In 1919 the Valley Natural Gas Co., operating in the Buena Vista Hills and Bakersfield areas, was purchased. This acquisition gave the Midway Gas Co. additional gas supply, pipe lines, and markets. Beginning with the latter part of 1922, the development of the fields in the so-called Los Angeles Basin was responsible for the rapid development of the pipe line system in Los Angeles County. In 1925 development of large quantities of natural gas in Ventura County brought about the construction of a 52-mile pipe line from Ventura to Castaic, with a compressor plant in the Ventura Avenue field.

Starting with a 120-mile transmission line and a single compressor plant of 3,000 hp., the company has expanded so that it now operates 636 miles of pipe line and twelve compressor plants, of 23,200 total hp.

The compressor plants at Taft and Ventura and the pipe lines from these plants to the West Glendale terminal constitute the largest unit in the Midway's entire system. The Taft compressor plant, shown in Fig. 4, consists of four 1,000 hp. and three 500-hp. gas-engine direct-driven compressor units, with necessary auxiliary equipment. There are two gas-collecting systems: one delivering gas at 50 lb. and the other at 175 lb. The capacity of the plant at 400 lb. discharge is 40,000,000 cu.ft. per day.

The Ventura Avenue compressor plant consists of three 760-hp., one 200-hp. and fourteen 170-hp. gas-engine direct-driven compressor units and auxiliary apparatus. Three additional 160-hp. units are under construction. Intake pressures range from 20 lb. to 50 lb., depending on the source from which gas is received. The capacity of the present plant at 400 lb. discharge is 30,000,000 cu.ft. a day. When the new addition is completed the plant's capacity will be increased to 32,500,000 cu.ft. a day.

The transmission system from the Buena Vista and Elk Hills fields, and Ventura Avenue field to Los

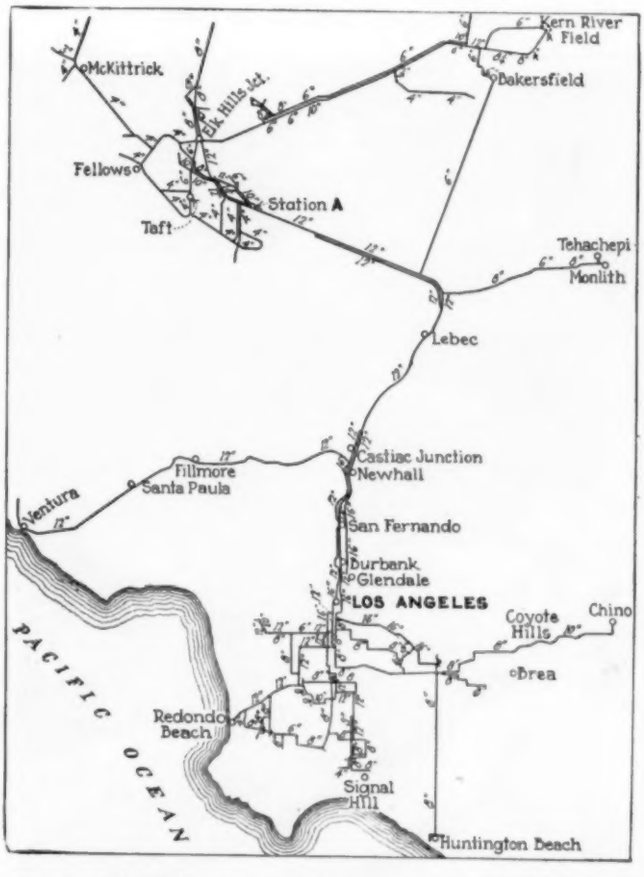


Fig. 1—Natural Gas Transmission Lines in Southern California

Fig. 2—Picture Taken During Installation of the Original Taft-Glendale Line
This view shows the new road, the ditch, some pipe in place, and the trail at the side of the ditch used for snaking pipe.

Angeles consists of one 12-in. line from Taft to Castaic Junction (80.5 miles) with a 30-mile parallel loop; one 12-in. line from Ventura to Castaic Junction (52 miles); and two 12-in. lines and one 16-in. line from Castaic Junction to Glendale Terminal (26.5 miles). With a pressure of 150 lb. at Castaic Junction and 50 lb. at Glendale Terminal the capacity of the system south of Castaic Junction is 65,000,000 cu.ft. a day. Two 16-in. lines carry the gas from Glendale Terminal to the gas works of the local distributing companies (Southern California Gas Co., and Los Angeles Gas and Electric Corporation) in Los Angeles. Natural gas introduced into the transmission system at 400 lb. initial pressure at Taft and Ventura reaches the plant of the local distributing companies, 115 miles away, at 20 lb. pressure, without supplemental compression en-route.

Fig. 3—Another Part of the Original Taft-Glendale Line

In the Los Angeles Basin eight compressor plants aggregating 12,700 hp. are operated. The pipe-line system in the Los Angeles area operates at somewhat lower pressure than either Taft or Ventura, due to the close proximity of producing oil fields to the markets. The plant discharge pressure ranges from 100 to 250 lb.

A typical small compressor plant such as the Inglewood station (Fig. 5), consists of: Eight 170-hp. gas-engine-driven compressor units; one 60-hp. auxiliary gas engine driving through shaft and belts, four centrifugal water pumps, one air compressor; one cooling tower and cooling coils for compressed gas and engine jacket water; steel buildings, station piping and measurement devices.

The Midway Gas Co. also operates a distributing system in the Taft and Kern River areas, supplying gas to

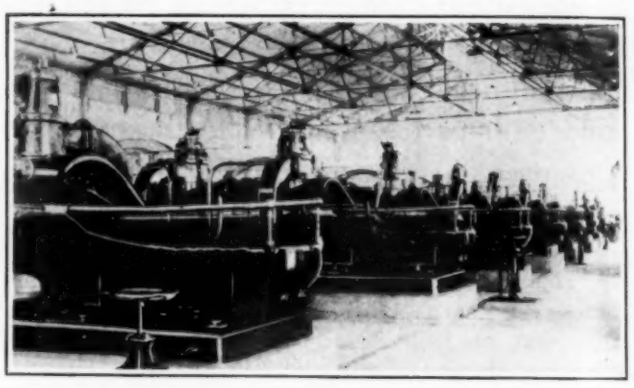


Fig. 4—Natural Gas Compressor Plant at Taft
These compressors are the largest gas engine driven compressor units in California.

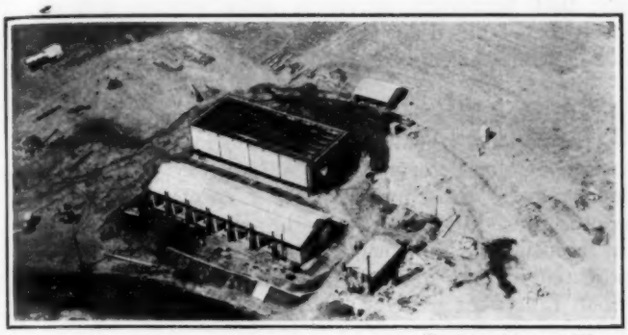
oil companies to operate their properties in the fields. In addition, the City of Bakersfield is supplied with natural gas through a local distributing company, the San Joaquin Light and Power Corporation.

The major portion of all gas transmitted is casinghead gas, that is, gas produced with oil and separated by the mechanical operation of a trap, located at or near the well. Practically all this casinghead gas must be compressed before entering the transmission system, since it is available at the well at uniformly low pressure and must be transmitted at relatively high pressure.

The complexity of pipe lines and the variation of load factor necessitated the establishment of dispatching offices in Taft and Los Angeles to properly co-ordinate the receipts and deliveries of natural gas. Pressures from all compressor plants and pipe line terminals, together with the volumes of gas through these terminals, are phoned hourly to the dispatcher's office. All gas entering Los Angeles County is controlled from the dispatcher's office in Los Angeles.

The duty of the dispatcher is to continuously regulate pressures on the pipe-line system so that demand will be properly met. On Saturday afternoons, during the summer season, for example, with the sudden cessation of industrial consumption, pressures must be reduced sufficiently ahead of time to avoid undue high pressure on the system. Likewise, in anticipation of heavy demand on a cold winter day, the pressures are increased during the early morning hours so that the system is "packed" to the maximum at the time of heavy demand.

Gas distribution company operations are so handled as to store a maximum amount of gas during off-peak hours—10 p.m. to 6 a.m. To make full use of the incoming natural gas (which is produced uniformly throughout



Rogers Airport Photo

Fig. 5—Inglewood Compressor Plant

the 24 hours) large storage facilities are required. Storage capacity in the Los Angeles metropolitan area aggregates 91,000,000 cu.ft.

In addition to the Midway Gas Co. there are three other agencies (Industrial Fuel Supply Co., Southern Counties Gas Co. and the City of Long Beach) which acquire, compress, and transport gas from various fields to the centers of distribution. The aggregate quantity of natural gas handled by all natural gas companies in Southern California at the present time is 250,000,000 cu.ft. a day. During summer and off-peak periods industrial consumers make up the bulk of the load. A partial list would include electric generating plants, pottery and special tile works, glass factories, railroad shops, cement mills, steel mills, packing houses, brick works and oil refineries. Gas is used extensively for house-heating during the colder months. The average domestic consumer in Los Angeles will use 2½ times as much gas (on an equivalent heat content basis) as a consumer in the San Francisco Bay region, due to the higher quality and lower cost of gas in Los Angeles, which factors make possible the more universal use and application of gas.

The author acknowledges the courtesy of the "Gas News" in supplying the photographs.

Pigments for Coloring Portland Cement Mortar

By James E. Foster
Chicago, Ill.

THE USE of color in conjunction with portland cement is showing a tendency to increase, owing to the widespread use of stucco and the recognition of concrete as an architectural as well as a structural material. Until recently there was little exact and specific knowledge of these coloring materials available. A study now under way at the research laboratory of the Portland Cement Association, Chicago, under the immediate direction of Raymond Wilson, associate chemist, is adding to the data on this subject. While the tests have not yet been completed, certain findings have been made, which throw light on the use of pigments in portland cement mortars.

A total of 264 pigments of the following types of chemical composition are being used:

Buff and yellow:

Iron oxide (ochre, sienna, artificial hydrated iron oxide)	53
Cadmium lithopone (cadmium sulfide and barium sulfate)	5
Zinc chromate	1
Organic color on an inert base	1
	60

Red:

Iron oxide, natural or artificial (over 85% Fe_2O_3)	47
Iron oxide[2] (less than 85% Fe_2O_3, remainder natural impurities)	27
Iron oxide, extended with calcium sulfate	9
Organic color on an inert base	2
	85

Green:

Chromium oxide	21
Mixture of chromium oxide and ultramarine blue	1
	22

Blue:

Ultramarine blue	15

Brown:

Iron oxide	15
Iron and manganese oxides, umber	18
Iron oxide and carbon	8
	41

Black:

Carbon black	19
Coal or coke	9
Iron oxide	5
Bone ash	5
Manganese Dioxide	1
Unidentified	3
	42

FROM this it may be seen that approximately 69 per cent of the pigments studied were either wholly or partially iron oxides and that more than 77.3 per cent are essentially made up of oxides or iron, manganese and chromium. Furthermore, in each class of hues with the exception of blue there was at least one group of this type of pigment.

With these pigments classified according to chemical make-up a series of tests was started in order to determine:

(1) The tinting value of commercial pigments.
(2) The relation between chemical composition of pigments and the color permanence of mortar exposed to natural climatic conditions.
(3) The effect of pigments on the compressive strength of mortars.

Data of the tinting value of different pigments, were secured by observing the color of the hardened mortar. Color permanence was determined by exposing specimens to the weather on a rack which faced the south and was tilted at an angle of 40 deg. and comparing them after a given period of time with similar specimens kept in a dark, dry place. The effect of pigments on compressive strength of mortar was studied by determining the crushing strength of cylindrical specimens 2 in. in diameter and 4 in. high containing varied quantities of representative pigments.

Tests made in which the proportion of a given pigment was varied showed a reasonably uniform hue except in those cases where the quantity of pigment was so low as to have a negligible effect on the color of the natural mortar. By the use of both white and gray

portland cement, it was found that in some cases, practically the same color of mortar can be produced in light gray cement as can be obtained in the white material, provided that a larger quantity of pigment is used.

With the red, yellow, green and black pigments there was very little difference in color between specimens in which the pigment equalled 35 per cent of the weight of the cement and those in which it equalled 50 per cent. The ultramarine had not, according to Mr. Wilson, apparently reached its limit at a 50 per cent admixture (ratio of pigment to portland cement by weight).

As an added amount of pigment has in practically all cases a negligible effect on the resulting color, the quantity used should for purely economic reasons be limited. For practical purposes an admixture of 20 per cent may be accepted as a maximum. The minimum is obviously 0 per cent. The exact proportion of pigment to cement must be determined specifically by the hue, chroma and value desired.

In the case of blacks, the tests showed that one unit of carbon black is approximately equal in effect on color to five units of iron oxide black. This does not necessarily mean that carbon is the better pigment, as will be seen further in this paper, when the compressive strength of mortar is discussed.

The specimens used in studying hues were mortar disks 4½ in. in diameter by 1 in. in thickness. The color was mathematically described by matching the specimen with a suitable combination of Munsell color disks.

In this paper the Munsell Nomenclature is used. The word "hue" refers to the color, e.g., red, blue, etc., "chroma" to the intensity of the hue; and "value" to its lightness or darkness. "Color" refers to a combination of hue, chroma and value.

THE SPECIMENS exposed to natural conditions were studied after periods ranging from two weeks to six months. The most important change in the color of a mortar due to fading of the pigment caused by weathering was a progressive weakening of the chroma. Accumulation of dirt and soot results in a lowering of the value, and, according to Mr. Wilson, no doubt also plays some part in causing the chroma to become weaker. In the tests so far made, the mortar disks were not washed after exposure, but the color studied was that found on them when they were removed from the exposure rack. One interesting observation in this connection was that after a hard rain, the value appeared to be somewhat higher and the chroma slightly stronger.

In studying colors in relation to exposure, the sand used in mixing the mortar must be taken into consideration in cases where the aggregate (sand and stone) is exposed. Its average color in the tests discussed here may be described according to the Munsell system as IY 5/2. A person familiar with the Munsell system will readily understand the character of the color changes in mortars of various hues in the cores where the abrasion resulted in the exposure of the sand. Green and red mortars underwent changes in hue and chroma in a direction toward the hue and chroma of the sand. Yellow mortars were not greatly affected in either hue or chroma. Those mortars which contained ultramarine blue did not change greatly in hue, but exhibited more marked changes in chroma, since the color of the sand was the complement of that of the pigment.

The effect of the sand on color changes may have been exaggerated in these tests, since the disks were exposed in a slanting position. Nevertheless, the findings indicate that perfectlty agreeable color effects will most surely be obtained by the use of aggregates (sand and stone) which harmonize in color with the pigments.

THESE TESTS seem to show that if a color is not permanent, it will fail after a short period of exposure. Color determinations showed comparatively little change in the chroma of most specimens after two months, and in cases where the pigment failed within six months, this failure was either complete or definitely indicated at two months. Aside from those pigments which failed completely, no differences in the degree of permanence of pigments developed during six months of exposure.

The following types of pigments showed permanent coloring qualities as a result of the six months' exposure:

Buff, yellow and red: iron oxide,
Green: chromium oxide,
Blue: ultramarine blue,
Brown: iron oxide, or iron and manganese oxide pigments.
Black: iron oxide, manganese dioxide, carbon black, bone ash and the so-called mineral blacks (coal, coke, and certain unidentified carbonaceous materials high in mineral matter).

The cadmium lithopones faded to a faint yellow during three months of exposure. After twenty-eight days the mortar colored with organic pigments had only traces of their original colors.

These failures are attributed by Mr. Wilson to the fading effect of sunlight, and not to any chemical action of the cement. He bases this conclusion on the fact that the surface of these specimens assumed colors comparable to that of uncolored cement, while below the surfaces, the colors were not greatly changed. This conclusion is further confirmed by the fact that the disks kept in the laboratory in the dark underwent no changes.

A zinc chromate failed because of chemical reaction with the cement. A 5 per cent admixture of this pigment caused quick stiffening of the mortar and the color faded almost completely within twenty-four hours; mortar containing a 10 per cent admixture solidified before mixing had been completed. The failures which were encountered with yellow pigments were probably the result of efforts to produce a satisfactory lemon yellow pigment.

In the tests performed to determine the effect of mineral oxide pigments on the strength of portland cement mortar color admixtures up to 20 per cent did not produce reductions in strength. The strength of mortars in which ultramarine blue was used increased.

DECREASED strength resulted from the use of carbon black. A 2 per cent admixture of this pigment reduced the strength of the mortar about 15 per cent and a 4 per cent admixture was accompanied by a strength reduction of 30 per cent. An iron oxide equal in pigment value to the two and four per cent admixtures of carbon black did not decrease the strength. It is apparent that the oxide is a better cement pigment than the carbon.

These conclusions regarding strength in its relation to pigmentation cannot be regarded as absolute, since the number of factors controlled in the experiments were necessarily limited. They nevertheless indicate that a mineral pigment, if used within economic limits, will not seriously decrease the strength of cement mortar.

Deterioration of Alloy Steels in Ammonia Synthesis

By J. S. Vanick

Consulting Metallurgist to the Fixed Nitrogen Research Laboratory

REACTIONS, such as the direct synthesis of ammonia from hydrogen and nitrogen, which require a combination of high pressures and high temperatures present unusually severe requirements for structural materials. The synthesis of ammonia is carried out at temperatures of approximately 500 deg. C. and at pressures of from 100 to 1,000 atmospheres, 1,500 to 15,000 lb. per sq.in. The combination of such pressures and temperatures, bad enough in itself, is rendered more severe by the corrosion or deterioration of the metal, due to the action of the gases, and the consequences of failures in service of such a system containing a flammable, explosive gas such as hydrogen, are obviously of a very serious nature.

AVAILABLE data on the physical properties of ordinary structural steels at elevated temperatures (Cf. *Bureau of Standards Technological Paper* 205) indicate that the combination of temperature and pressure is serious but can be handled provided corrosion or deterioration of the steels is eliminated. This paper is concerned with the deterioration during the synthesis of ammonia of materials which originally possessed the requisite physical properties. Two of the author's previous papers have described the deterioration of steel and wrought iron tubes in hot gaseous ammonia (*Trans. Am. Soc. Steel Treating,* vol. 4, page 62 [1923] and the deterioration of several metals in hot reducing ammonia gas (*Proc. A. S. T. M.,* vol. 24, No. 11, page 348 [1924]). Microscopic examination, supplemented by tensile tests before and after exposure, showed that wrought iron, mild steel, copper, nickel and certain alloys all deteriorated rapidly when exposed to gaseous mixtures of nitrogen, hydrogen and ammonia under the conditions which prevail in either the synthesis or cracking of ammonia. These results may be summarized as follows:

In the synthesis of ammonia at 100 atmospheres pressure and 500 deg. C., most of the metals tested were seriously impaired through intergranular fissuring. These failures and the one noteworthy case of resistance to attack (shown by a chromium-nickel-silicon-iron alloy) led to the following conclusions:

1. The removal of elements such as carbon or oxygen or their compounds through reaction with hydrogen encourages voiding and fissuring, while the presence of chromium in forming more stable nitrides and retarding the diffusion and penetration of the gas, assists in resisting deterioration.

2. Fissuring is induced by dissolved hydrogen, made soluble by activation from infiltration through the metal or by release from ammonia which is rendered unstable in contact with the catalytic metal surfaces.

3. The more rapid diffusion and effusion of hydrogen, in contrast to the other gases of the mixture, permits an ammonia enrichment to the extent of developing a localized super-equilibrium, with the alternate formation and decomposition of nitrides as a result.

RESISTANCE to deterioration shown by the chromium-nickel-silicon-iron alloy suggested further tests of a number of chromium steels and alloys. Test conditions were chosen to simulate operating conditions in the synthesis of ammonia, namely 500 deg. C., 100 atmospheres pressure, and an ammonia concentration of 8.3 per cent in a gas containing hydrogen and nitrogen in the proportion of N_2:$3H_2$. The test specimens were in the form of cylinders, one for each steel or alloy, as shown in Fig. 1. Each had a volume capacity sufficiently large to accommodate two tensile, two Charpy impact, and two corrosion specimens of the usual shape and having the same composition and preliminary treatment as the cylinder. These specimens were exposed on all sides to attack by the hot gases but were not subjected to the constant stress of 100 atmospheres pressure, as were the test cylinders. Each material was to be exposed until failure of the cylinder occurred or metal deterioration had progressed to a point where further exposure would yield little additional information.

Cylinders for high-pressure tests were arranged in a series of five parallel layers, five cylinders to a layer, the whole being heated by suitable electrical units. The assembly of specimens, with heating coils and outer shell (raised to show the interior of the assembly) and the complete apparatus, are shown in Figs. 2 and 3. In addition to the heating coils which can be seen in Fig. 2, grids at the top and bottom of the assembly provided for the heating of the nest of cylinders from all sides. The temperature was controlled by means of iron—constantan thermocouples suitably located. The furnaces were jacketed with magnesia and the heating arrangements

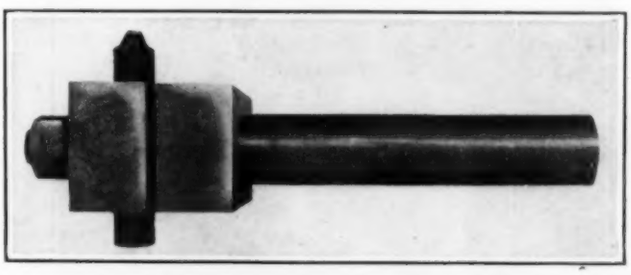


Fig. 1—One of the Test Cylinders
As shown here it is approximately one-fifth of its actual size.

Abstrated from a report of the U. S. Bureau of Standards which will appear in the August issue of the *Transactions of the American Society for Steel Treating.*

were found to give very satisfactorily uniform temperature.

The auxiliary furnace shown at *B* in Fig. 3, consisted of a steel cylinder, capped top and bottom with heavy flanged joints and electrically heated. Duplicate corrosion specimens were suspended from the head of this bomb, exposed to the heat and gases within. Periodic examination of test specimens from this bomb indicated the probable state of the specimens in the main test bomb.

The requisite concentration of ammonia in the test gases was obtained by first passing the gases under pressure through one of the two catalyst bombs shown at *C* in Fig. 3, between the two insulated furnaces. The construction of these catalyst bombs and the generation, purification and compression of the gases has been described in detail by R. S. Tour in *Chem. & Met.*, vol. 26, page 588 (1922).

The ammonia concentration of the gases was determined at the exit of each catalyst bomb and steel specimen furnace. Apparatus for the sampling and analysis of the gas is shown at *A* in Fig. 3. A flow meter indicated the amount of leakage from the high-pressure cylinders and connections into the furnace shell and a mercury safety trap provided for the release of the pressure from accumulated leakage and provided a vent for the sudden release of high-pressure gas which would accompany failure of connections or rupture of a test cylinder.

Emergency storage cylinders, the tops of which appear in Fig. 3, just back of the corrosion specimen furnace, were used in case of any interruption in the normal gas supply.

Preliminary Tests—No quantitative data on the ability of commercial steels to withstand the conditions of ammonia synthesis were available, to aid in the choice of samples. Some work by H. E. Wheeler (*Trans. Am. Inst. Min. Met. Eng.*, vol. 67, page 257 [1922]), indicated a decided superiority of a chrome-vanadium steel, but Wheeler's short exposure tests were admittedly "far from quantitative and could merely give a general idea of the effect upon different families of elements." It will be shown later that short exposures may yield inconsistent if not misleading results. The first set of steel samples were therefore selected to cover a variety of compositions.

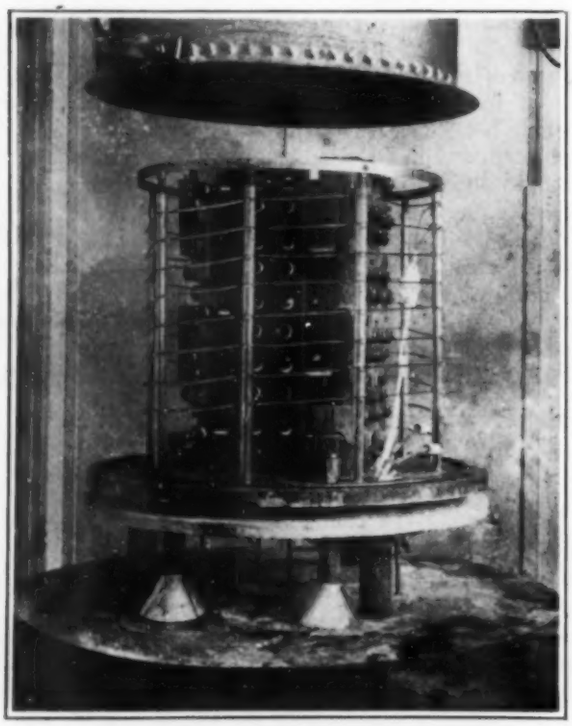


Fig. 2—Assembly of Test Cylinders

All of the steels were given an annealing treatment before being made up into bombs and specimens. They were then exposed to the N_2:$3H_2$ gas mixture containing 8.3 per cent ammonia, at 100 atmospheres and 500 deg. C., for four months. During this period, additional corrosion specimens were removed from the auxiliary furnace at intervals of one, two and four months to trace the rate of deterioration. After exposure, tensile test specimens cut from the bomb walls and specimens comprising the charge in the bomb were tested in tension and impact. Macroscopic and microscopic examinations were made of bomb sections and corrosion specimens. Chemical analysis of the affected zones of specimens were made in a few instances to check microscopic observations, and it was soon demonstrated that final judgment could not be rendered on any one test or property alone, but must be based on a composite of all the information available.

Very little change was shown in any of the samples during the first two weeks. With longer exposures, fissuring and decarbonization occurred, usually associated but sometimes independent of each other, and varying widely in degree or severity. Two types of penetration were observed, the uniform or concentrically regular inward migration and the selective or tendril type of advance, the latter being harder to detect or evaluate and consequently more dangerous. The origin and progress of fissures along slag spills was frequently noted. Decarbonization and penetration were evident in the dark rims of the specimens, the affected area extending clear to the core in some cases. Microscopic fissures in some cases preceded, and in others followed the decarbonization; and the tendril type of progressive decarbonization was shown by certain samples.

Preliminary Conclusions—A summary of all the data from the first series warranted the following preliminary conclusions:

1. In a comparison of the high- and low-carbon steels, the net results indicate a lesser deterioration for the low-carbon steels, although specimens of both were penetrated to their very centers after four months' exposure.

2. Nickel steels show a distinctive type of selective fissuring, reaching to the core of the specimen in some of the four-month exposures.

3. Chromium steels within the low range of chromium studied in this series, also suffer from the treacherous "tendril" form of penetration. It appears that high-chromium contents offered greater resistance to penetration, while higher-carbon contents permitted greater fissuring and voiding in the penetrated zone.

4. Nickel-chromium steels reflect the influence of both elements.

5. A tungsten-chromium steel is apparently the least affected of any in this group. Except for intergranular fissures close to the surface of this specimen, very little evidence of attack by the gases was available. This composition is undeniably superior to its companions, notwithstanding an initially high carbon content.

The improvement shown by an ordinary chrome-

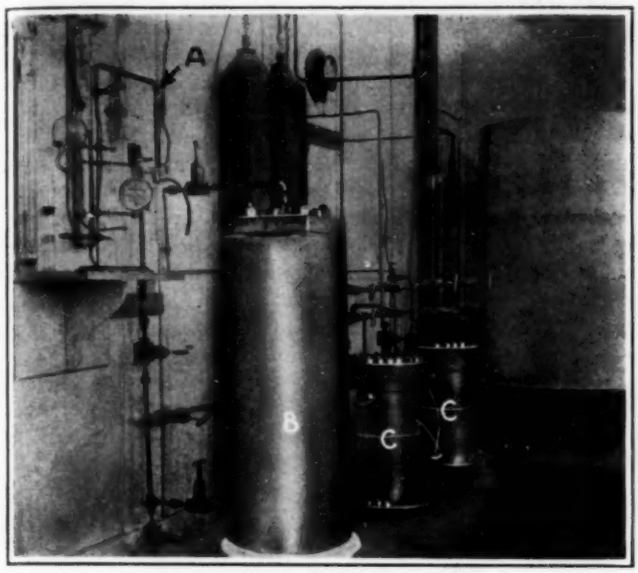


Fig. 3—Complete Testing Apparatus

vanadium steel over steels previously tested, suggested the possibility of securing still more favorable results from a manipulation of the three principal alloying elements in this steel, namely chromium, vanadium and carbon. In view of the commercial availability of a chrome-vanadium steel, it seemed better to follow this lead rather than the one suggested by the decided superiority of the chrome-tungsten steel in the experiments just cited. The compositions chosen, therefore, represented three series, in each of which one of the three main constituents is varied while the other two are maintained constant. Two steels of the stainless type were added to the list to expand the chromium series to steels containing 21 per cent of that element. Samples of the commercial .30 carbon chrome-vanadium steel used in earlier tests were included with each of these series for comparison.

Results of Final Tests—The samples were double annealed to release strains, as before, and were shaped into bombs and specimens which were exposed to 8.3 per cent ammonia in hydrogen-nitrogen gas at 500 deg. C. and 100 atmospheres pressure. The exposure lasted ten months with periodic examination of auxiliary specimens. At the end of ten months, the bombs and specimens were removed and subjected to the routine procedure of tensile, impact, macroscopic and microscopic tests.

The group of fourteen steels chosen to cover variations of the carbon, chromium and vanadium contents of an ordinary chrome-vanadium steel, within the limits of 0 to 1.20 per cent C; 0 to 14.0 per cent Cr; and 0 to 0.65 per cent V, showed that:

1. The carbon content must be low.
2. Two per cent or more chromium is necessary to confine the fissuring and decarbonization to a smooth and uniform penetration.
3. A suitable steel would contain at least 2.25 per cent chromium with not more than 0.30 per cent carbon.
4. Larger quantities of chromium improve the resistance further, but not in proportion to the increase in chromium.
5. High-chromium and chrome-nickel steels of the stainless type are most resistant but are difficult to forge and machine.
6. Heat treatment is useful to dissolve the alloys in steel inherently resistant, but adds little or no improvement to partly successful steels.
7. Vanadium adds no appreciable improvement.
8. The chief features of the attack of the gases upon the steels were represented by: (a) decarbonization; (b) sharp increase in combined nitrogen principally in the chromium steels; (c) fissuring, voiding, or porosity in the affected zones; and (d) lowered strength and ductility.

DETERIORATION of the steels is a form of corrosion and may be explained by means of chemical reactions with three factors, temperature, pressure and concentration of reactants, intimately related in the determination of the rate, course and intensity of deterioration. Aside from their influence on gaseous equilibrium conditions, pressure and temperature are significant in the stress exerted on the metal fibers and in increasing the diffusivity of the gases. The reactions proposed for consideration are as follows:

$$(1)\ FeO+H_2 \rightleftarrows Fe+H_2O$$
$$(2)\ Fe_3C+H_2 \rightleftarrows CH_4+Fe$$
$$(3)\ Fe_3C+H_2O \rightleftarrows CO+Fe+H_2$$
$$(4)\ NH_3 \rightleftarrows N_2+3H_2$$
$$(5)\ NH_3+Fe \rightleftarrows Fe_xN_y+H_2$$
$$(6)\ NH_3+Fe_xCr_y \rightleftarrows Fe_xCr_yN_z+H_2$$

It is well known that hydrogen will reduce oxides of iron at elevated temperatures, as in equation (1). Decarbonization occurs under the same conditions, presumably forming hydrocarbons, as in equation (2). The analyses before and after exposure confirm microscopic evidence of decarbonization.

A complete chemical explanation of all the deterioration phenomena would involve a cyclic reaction comprising an alternate accumulation and decomposition of ammonia. To conform to this explanation, the metal must act as a porous filter permitting the passage of hydrogen and damming up the ammonia to a super-equilibrium concentration. This ammonia by means of reactions (4), (5) and (6) would intensify and complete the destruction already begun through reactions (1), (2) and (3).

Reaction (4) might be developed by the catalytic effect of the metallic surfaces upon a sub-equilibrium concentration of ammonia to produce simultaneous, compensating synthesis and cracking, or by a local enrichment of ammonia. Such local enrichment, which would promote reaction (5), could develop from the more rapid diffusion and effusion of hydrogen into the metal and by the combination of hydrogen with oxides, carbides, etc. Nitrides so formed would in turn be decomposed and washed out by fresh, incoming sub-equilibrium gas. Both reactions (4) and (5) would develop atomic or activated hydrogen which would account for the puffing or swelling of the steels, although some of the observed surface cracking may have been from the mechanical action of escaping products from reactions (1), (2) and (3).

Reaction (6) illustrates the nitrification of high-chromium steels, observed as dark solid solutions in their microstructure. Chemical analysis of thin layers machined from the specimens showed an increase in nitrogen content of the metal.

In the low-chromium steels the presence of nitrogen as a solid solution was not detectable. The absence of nitrides in the microstructure of most of the steels suggests either that nitrogen or ammonia are not participating in the destruction and deterioration due to hydrogen, or that under the existing conditions chromium

TABLE I. Percentage Composition of Ten Steels Used in First Series of Tests

Serial No.	S.A.E Specification No.	C	Mn	P	S	Si	Cr	Ni
31	1020	.19	.43	.008	.033	.17		
32	1095	1.01	.40	.007	.036	.16		
33	2330	.24	.52	.008	.032	.03		3.43
34	6130*	.30	.68	.012	.024	.26	.93	
35	3335	.39	.70	.011	.044	.29	.84	3.56
36	3230	.27	.59	.014	.022	.13	1.00	1.60
37	52100	.93	.30	.010	.014	.21	1.47	
38	5140	.48	.79	.030	.029	.23	.60	
39	7260**	.58	.36	.004	.017		.55	.21
40	2512	.10	.31	.008	.023	.31		4.87

* Contained 0.18 per cent V. ** Contained 1.62 per cent W.

forms stable nitrides which obstruct the action of hydrogen while the nitrides of other elements are unstable and decompose as soon as they are formed. No exposures of prolonged duration were made in hydrogen, but, from short exposures and from a survey of the literature, it is doubtful whether deterioration approaching in severity that shown by these steels had ever been observed in steels exposed to molecular hydrogen. It is believed, therefore, that active hydrogen and nitrogen or ammonia are the destructive influences and that their activity is limited in certain cases by the formation of impermeable solid solutions containing chromium nitride.

Physical features obtained from the tests and microexaminations, support the proposed explanation. The progress of the attack on the steels is marked by a succession of: (1) loss in strength and ductility, (2) decarbonization, and (3) fissuring.

The first evidence of a change in the condition of the steels was observed in an inspection of the 14-day exposure specimens, some of which showed partial decarbonization penetrating for an appreciable depth and manifested by a bleaching in tone of the usually dark, pearlitic areas. In resistant steels decarbonization proceeds slowly and the line of advance corresponds to the surface contour. In less resistant steels, the initial uniform decarbonization usually becomes a selective penetration extending in advance of the decarbonized ring.

The influence of alloying elements, particularly chromium, is apparent in the restricted decarbonization and absence of selective fissuring in the higher-chromium steels. Similar results are reported by Campbell, Ross and Fink: *J. Iron and Steel Inst.*, vol. 108, No. 11, page 173 (1923) and by C. R. Austin: *J. Iron and Steel Inst.*, vol. 105, No. 1, page 93 (1922). While some of the resistance to deterioration may be ascribed to the greater stability of the chromium carbides in the hydrogen-rich mixture, the position and extent of the bleached band in the austenitic high-chromium steels indicates that the solid solution of chromium, iron and carbon offers considerable resistance to the diffusion of hydrogen. Therefore, the chromium most directly concerned in obstructing the infiltration of the gas is that portion which is in solid solution in the steel. This suggests the probable superiority of a low carbon, chromium-rich steel. The improvement which might be expected in the vanadium steels as a result of the combination of vanadium with some of the carbon, thereby liberating chromium, was not realized. The vanadium group of steels was severely fissured and decarbonized. The nickel steels show a concentric type of fissuring, interesting since it apparently does not appreciably reduce the tangential or longitudinal strength of the test cylinders.

The author acknowledges his indebtedness to Capt. Tour, Dr. Tolman, Dr. Cottrell and Dr. Larson, of the Fixed Nitrogen Research Laboratory, in the preparation and exposure of specimens; to Dr. G. K. Burgess, Director, Bureau of Standards, for the use of the laboratory and facilities necessary for the metallographic work; and to Dr. J. G. Thompson of the Fixed Nitrogen Research Laboratory for the revision and editing of this manuscript.

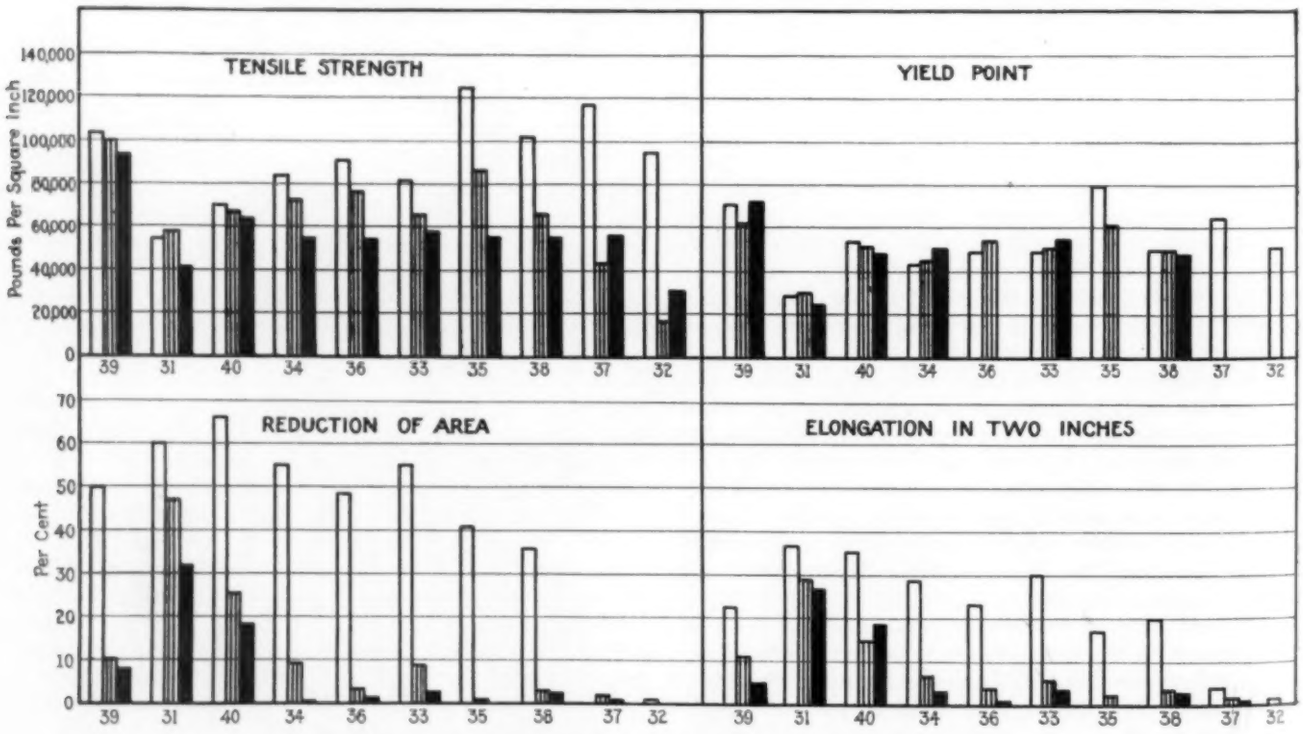


Fig. 1—Some Physical Properties of the Ten Steels Used in First Tests

In each case the first or unshaded bar is the test on the original sample; the center or shaded bar is with the bomb wall exposed and the third or solid bar is the exposed test of the tensile specimen. The numbers at bottom refer to the compositions given in Table 1. Charpy impact tests were also made on all original and tensile specimens.

New Chemical Industries in ALABAMA *Will Follow Development of Latent Resources*

By Stewart J. Lloyd

Professor of Chemical Engineering, University of Alabama

FOLLOWING is a frank account of the chemical industry of Alabama, its present condition and future prospects. It contains a plain statement of facts, expressed as far as possible in figures, with deficiencies in resources noted, as well as manifest advantages shown. There is also included a discussion of general conditions, such as geology, climate and power facilities, as well as a description of the basic metallurgical industry, iron and steel, which dominates the industrial life of the state. Only in this way can the proper setting be provided for the later discussion of purely chemical matters.

No apology is necessary for this reference to geology since the industrial development of the state depended to an exceptional degree upon its geological peculiarities. A revised geological map just issued by the Alabama Geological Department in co-operation with the U. S. Geological Survey divides the state, like ancient Gaul, into three parts. Part I contains the oldest rocks, the crystalline, pre-Cambrian or Archaean series. Here we have the granites, norites, schists, slates, phyllites, etc. and in them are commercial marbles, graphite, gold mines (of the kind you put gold into), a little pyrite, mica, asbestos (amphibole), and some very remarkable primary kaolins. The marble and the graphite are of present commercial importance, and in the closing year of the war this field furnished more than 50 per cent of the graphite output of the United States. The area of this division is a little over 5,000 sq. miles.

Division II is the area of Palaeozoic rocks, from the bottom of the Cambrian to the top of the Coal Measures. This is of course the important mineral area of the state. Coal, iron, manganese, bauxite, asphalt rock, barite, tripoli, shales, clay, limestone, sandstone, quartzite, all occur here. The value of the mineral output from this section must exceed 90 per cent of that of the whole state. Division III is the Coastal Plain, embracing all formations younger than the Coal Measures. Sands, clays and limestones make up the surface. Bauxite is found in this territory in some quantity, while lignite extends through it irregularly across the state. An extraordinary deposit of sand and gravel is found in the Montgomery district.

IRON and steel making has dominated Alabama chemical industry from the beginning and continues to do so. If the reader will look at the accompanying map he cannot fail to note that the three things, besides air, needed to make pig iron, viz. iron ore, coking coal and flux, are all available in Alabama.

Two kinds of iron ore are used now in Alabama steel plants, while a third may or may not come into use. These two ores are of unequal importance. Useful deposits of the important one, the red ore, which is the mainstay of the district, extends from Birmingham to Bessemer, fourteen miles, with another bed at Attalla, sixty miles to the northeast. This ore lies in beds like limestone or sandstone, and is subject to all the structural peculiarities of such beds such as faulting and gentle folding. There are at least two billion tons of this ore available. A serious disadvantage of this red ore and one not generally recognized is its low grade. The average iron content of the material sent to the furnaces will not exceed 35 per cent.

The map also shows most of the occurrences of the second commercial ore, brown ore or limonite, resembling the "bog ore" of the north. This does not occur in beds but in lumps or nodules scattered through clay, from which they must be washed clean. Although of higher grade than the red hematite these do not constitute more than 25 per cent of the total ore used. Seventy-five million tons of this are available. The third kind, the gray ore, which looks much like slate, is shown as a solid body on this same map. It is high grade, highly siliceous, and contains more potash than any other iron ore known. No use is now made of it.

In 1923 Alabama produced nearly three million tons of pig iron, almost entirely from local ore. Pennsylvania, for comparison, produced just under fifteen million tons, mostly from extra-state ore.

Iron ore as a promoter of industry is not of much consequence without coking coal. The coal fields of Alabama are four in number. Two of these, Nos. 2

Geological Divisions, Coal, Iron and Hydro-Electric Power Resources of Alabama

and 3 on the map shown here, are of present importance. It should be observed that Birmingham is located *between* the two important coal fields and close to the iron ore as well. But just as this iron ore situation has the disadvantage of low-grade materials, so also is there a drawback to the coal resources. Alabama coal seams are likely to be thin, and the percentage of ash is above the average. According to a well informed local coal operator, there are more coal washers in Alabama than in all the other states of the Union combined.

The total available coal reserves in the state are about seventy billion tons. Some twenty million are mined annually, so that 3,500 years would be required to use it all at present rate of consumption. According to Burchard, the percentage of this which is coking coal, or rather which can be coked by present methods, is just about sufficient to smelt all the ore, so that the two essentials are in good balance.

The third raw material, dolomite, occurs exactly where it should, between the iron and the coal. One of the compensations for the low grade of the iron ore is its partial self-fluxing character, which cuts down materially the amount of flux which must be added.

JUST as iron and steel are responsible for the existence of numerous chemical industries, so is the basic industry of agriculture. Alabama is a cotton and corn state, but must import some corn for her own use. Cotton, or rather cotton seed, is the source of oil, which is pressed from the seed in numerous mills throughout the state. Fertilizers are in general use, and their manufacture constitutes a major industry.

So far as agriculture is concerned the long season of frostless days offers certain advantages not yet adequately appreciated. A map indicating the number of growing days, that is the days between the last frost of spring and the first of the following winter, shows quite a variety of climates within the state, the number of growing days ranging from 325 near Mobile to 200 on the Tennessee line.

The industrial development of any state is likely to be dependent upon its power resources. These are shown in part in the accompanying map. On the Coosa River there are two large modern hydro-electric installations, both run-of-river plants of about 100,000 kw. each. Martin Dam on the Tallapoosa is a storage plant of 180,000 hp., in the making of which was created the largest artificial lake in the world. Another still larger run-of-river power plant on the Coosa at Lock 18 will be completed in 1928. There are numerous other places on both these rivers which will ultimately be developed. On the Tennessee at the famous (or notorious) Muscle Shoals is Wilson Dam, now completed and in operation. One dam will ultimately be built below it, and two above it in the state. Two large steam plants, at Gorgas and at Wilson Dam, are in operation and others are contemplated. Even at present, without the addition of these future developments there is no part of the country more adequately provided with power than Alabama.

During the extraordinarily dry summer and fall of 1925, when trees fifty years old died from lack of moisture, no user of power in Alabama was forced to curtail his operations, and in addition large blocks of power were exported to neighboring states to relieve the serious situation there. The recent formation of the Southeastern Power and Light Company, embracing many operating power companies of the southeast has already resulted in notable economies in coal consumption by calling upon one watershed to make good the rainfall deficiencies of another. In this organization the Alabama Power Company occupies a strategic position, by reason of its proximity to both hydro sites and to coal.

A recent forecast, made with much care, of the future consumption of electric power, both steam and hydro generated for 1940 gave a figure of 21 billion kw.hr. for the southeast. The 1926 figure was 7 billion.

Alabama Chemical Production

THE foregoing is intended to present a background, on which to project the purely chemical data. First in importance are those materials associated directly or indirectly with the iron and steel industry.

Light Oils. Somewhat less than 5,000,000 tons of coke are made yearly in byproduct ovens, at Birmingham, Alabama City, and Holt. The light oil produced therewith, some 26 million gallons, is consumed to the extent of 70 per cent as a blended motor fuel, most of it quite locally. During the war it was almost all devoted to the manufacture of munitions. None of it is worked up into more complex and more valuable coal-tar products within the state.

Naphthalene. From the same source is obtained the naphthalene which is in part shipped away in the crude state, although some is refined by the Naphthalene Products Company of North Birmingham and manufactured into moth balls.

Ammonium sulphate. About 70,000 tons per year of ammonium sulphate made from the ammonia of the coke ovens and from local or Tennessee sulphuric acid is marketed almost exclusively as a fertilizer. The southeast is proportionately the largest consumer of ammonium sulphate.

By-product Gas. As another product of the ovens, gas is used, as elsewhere, by the ovens themselves to the extent of 50 per cent. The surplus goes to municipalities and to neighboring industries. The cities of Birmingham and Tuscaloosa are supplied with gas from this source. This total surplus amounts to about 75,000,-

000 cu.ft. per day. It could, of course, be used for chemical purposes such as the fixation of nitrogen, if it could be demonstrated that such use would bring a greater return than the present disposition. There is very little gas actually wasted.

Coal Tar. The Birmingham district is the largest producer of cast-iron pipe in the world, and naturally a large consumer of coal tar for dipping this pipe. Out of the total production of 75,000,000 gal. a considerable part is distilled and worked up locally, for roofing materials, pitch, etc., by The Barrett Company and the American Tar Products Company. The remainder is used in the cast-iron pipe industry as noted above or shipped north.

Explosives. Associated both with coal and iron, in their mining, is the production of explosives. A large plant is under construction now for the du Pont company some miles from Birmingham, which will supply some of the explosives now imported into the district. There are manufactured now in the state: 1,350,000 lb. of black blasting powder and 1,000,000 lb. of dynamite. The yearly consumption is approximately 2,625,700 lb. of black blasting powder, 9,186,700 lb. of high explosives (other than permissible), and 5,670,000 lb. of permissible explosives (coal mining). Obviously the following amounts are imported: 1,275,000 lb. of black blasting powder, 8,186,700 lb. of high explosives and 5,670,000 lb. of permissible explosives.

Evidently there is room for the additional manufacturing plant, as has been recognized by the du Pont company.

Large Output of Sulphuric Acid

Sulphuric Acid. Sulphuric acid enters into so many different manufactures that it cannot be classed under any one heading. Steel, fertilizers, explosives, all use their quotas. There are no contact-process plants in the state, but there are numerous chamber plants, large and small, most of them auxiliaries to acid phosphate fertilizer factories. Some 50,000 tons of acid, calculated to 50 deg. Bé. are made in the Birmingham district, approximately 75,000 in Montgomery, and 50,000 elsewhere, in Roanoke, Opelika, Troy, Dothan, etc., making a total of 225,000 tons. Approximately the same amounts are consumed, although importations are occasionally made from the byproduct plants of Copperhill and Ducktown in Tennessee. The Birmingham district consumes about 25,000 tons of 52 deg. Bé. acid, 73,000 tons of 60 deg. Bé. and only 5,000 tons of 66 deg. Bé.

Pickling of steel, neutralization of ammonia liquor and the making of explosives, and acid phosphate consume nearly all of the acid. No large deposits of pyrites have so far been uncovered in the state, and sulphur from the Gulf Coast is generally used, coming up the Warrior River on barges to Birmingham.

Acid Phosphate. The southeast is a heavy and persitent user of chemical fertilizers, and the chief of which is acid phosphate. No high grade phosphate rock has been found within the borders of the state, but the Florida and Tennessee fields, the most important in the east, are just to the north and south. The state is dotted with acid phosphate plants, 15 in number, which in 1926 produced approximately 150,000 tons of acid phosphate.

The Tennessee Coal, Iron and R.R. Company at Ensley produces a slag phosphate from its open hearths which is in much demand, as is the corresponding Thomas slag abroad.

Cotton-Seed Oil. As would be expected from a cotton state, Alabama produces much cotton-seed oil, but no hydrogenation plant exists within her borders, and the oil is shipped either to Savannah or to Cincinnati for treatment.

Portland Cement. This is an important product of the territory. There is no point in Alabama more than sixty miles from a good limestone bed, good coal is abundant, shale likewise, and plenty of electric power. One plant at Demopolis utilizes the clayey Selma chalk, a true cement rock; plants at Ragland and at Leeds use the "Trenton" limestone, while the three clustered around Birmingham rely upon Cambrian (Coosa) limestone. Altogether they turn out some 12,000,000 bbl. and 600,000 bbl. of "slag" cement were produced in 1924, in addition to the output of the portland plants proper. The feature of the past year has been the putting in operation of the ultra-modern plant of the Phœnix Cement Company, at Powderly, near Birmingham. This plant has two kilns, each 342 ft. long, the longest piece of moving machinery in the world, and the plant as a whole is said to be the last word in cement manufacture.

Lime. The abundance of high-grade limestone in the state has naturally been reflected in lime production. The ratio of chemical lime to total lime is higher in Alabama than in any other state. Much of this very pure lime is exported beyond the state borders. Many of these plants have been concentrated at a point about 30 miles south of Birmingham, but evidence of a beneficial spreading is apparent. The Tennessee valley now contains two, in addition to the idle plant belonging to Plant No. 2 at Muscle Shoals. In 1923, twelve plants produced a little less than 200,000 tons. This includes both quick and hydrated lime.

A Flourishing Chemical Industry

Phosphate Products. The chemicals so far mentioned as produced in the state are largely consumed therein, except perhaps the cement and lime. Alabama possesses at Anniston, however, a unique chemical industry which exports almost all its products to other states. This is the Federal Phosphorus Company, which manufactures high purity phosphoric acid of several strengths, monosodium, disodium and trisodium phosphate, monoammonium phosphate, pyrophosphates, various calcium phosphates, and ferrophosphorus. Located half way between the Florida and Tennessee phosphate fields, supplied with cheap electric power for its furnaces, and operated by an efficient and forward-looking organization, it is a striking example of a well-designed and flourishing chemical industry.

Abrasives. The allied Federal Abrasives Company and Federal Carbide Company, under the same management as the phosphorus company, produce during the season of off-peak power, silicon carbide, aluminous abrasives, calcium carbide and ferrosilicon. These also are largely sent outside the state. Statistics of production cannot be given for these materials, as there is but one producer.

Fixed Nitrogen. A list of Alabama chemical products would be incomplete without a reference to the two Government plants at Sheffield (Muscle Shoals), one with a capacity of 40,000 tons of nitrogen as ammonium nitrate by the cyanamide method, the other a synthetic ammonia installation of much smaller size. These have been idle since the end of the war despite the valiant struggles of Congress to take some action regarding them. They stand as silent witnesses to the fact that Government and industry do not mix.

THE following formidable list contains the chemicals used but not made at present in Alabama. The amounts mentioned should be regarded as approximate only, and refer to the year 1926.

First in importance is *soda ash*, of which 12,000,000 lb. is required. Much of this is used in water purification, and by the large steel and iron companies. Probably the largest individual user however is the Federal Phosphorus Company at Anniston.

About 5,000,000 lb. of *caustic soda* is used annually in the state, with the Federal Phosphorus Company again the largest consumer. The nearest point of production is Saltville, Virginia, 400 miles away.

Anhydrous ammonia, for refrigeration, is imported to the amount of 350,000 lb. mostly from Niagara and from Charleston, W. Va.

Sodium sulphide is used by two textile mills to the extent of 125,000 lb. and is imported.

About 650,000 lb. of *sodium silicate* is imported mainly by the makers of corrugated paper boxes. An effort to supply this demand locally, a demand which is increasing rapidly, is being made by the Grasselli company, and by the Naphthalene Products Company, both of whom are now erecting plants.

Commrcial alum (aluminium sulphate). One million lb. of this material are required for water purification, and some minor purposes. Most of it comes from Chattanooga, just over the state line. Iron free alum, (used in vegetable pickling) has a smaller consumption—75,000 lb.

Over 1,000 tons of *muriatic acid* are brought in, mostly for galvanizing and pickling purposes. Acetic acid mostly used in laundries, reaches the total of 100,000 lb. Of *glauber's salt*, used for sizing, 350,000 lb. are used.

No figure on *nitric acid* consumption could be secured, but it is believed a fair estimate would be 500,000 lb.

A complete catalog of the raw materials for chemical industry available in Alabama would occupy too much space. Instead there is given a short list of those which have *not* so far been found in quantity within the state.

Imported Raw Materials

Salt. No commercial salt deposits have been found. Salt brines that are not saturated, however, have been known for a century near Jackson, Clark county, and during the Civil War these helped to supply the Confederacy. Other concentrated brines are found on an island in Mobile Bay. It is the writer's belief that solid salt in quantity underlies these Jackson wells, although it is only fair to say that this belief is not shared by all geologists who have studied the area in question.

The evaporation of sea water was practised likewise along the Alabama and Florida gulf coast during the Civil War. There is some reason to believe that this operation could be profitably practised here again.

Much progress has been made in such work recently, especially by the Italians in North Africa.

The nearest supply of salt, available at present is, of course, on the Louisiana coast.

Petroleum. The oil secured in Alabama to date amounts to only a few barrels. There are, however, only about eight thousand square miles out of an area of 52,000 miles which can be regarded as entirely hopeless for oil discovery. Natural gas has been slightly more abundant, but is not at present flowing in sufficient quantity to make it of industrial interest.

Gypsum. Alabama is lacking in gypsum as is the whole southeast. Saltville, Virginia, and Arkansas are the nearest sources of supply.

New Industries Needed

An examination of the preceding list of materials imported into the state as well as a study of raw materials indicates rather plainly the chemical industries now lacking which should be established here. First on the list is caustic soda and soda ash, for which a market already exists, and which come long distances. Cheap power, cheap and abundant coal, and Louisiana salt if local supplies are not developed, are all available to a prospective alkali manufacturer.

No wood-pulp plant has yet begun operations, although there are indications of the early starting of two plants, for kraft paper, in the western part of the state.

The southeast will long be a heavy user of fertilizer. The logical place for a synthetic ammonia plant is unquestionably in the Warrior coal field, west of Birmingham. By combining it with phosphoric acid made by a method now being developed, ammonium phosphate, should be produced at the present cost of ammonium sulphate, but with three times its plant food. The by-product gas of the coke ovens may yet serve as a source of hydrogen for such a plant.

The closer a country is to the tropics, the greater is its need for insecticides. The only deposit of arsenic, in the southeast occurs in Clay and Randolph counties. There is sufficient lead in this deposit to help carry the mining and treatment charges. Lead arsenate and calcium arsenate, as well as paris green, should be made here. A plant for making calcium arsenate electrolytically exists at Montgomery, but has not operated for two years.

The extraordinary growth in the consumption of soft drinks would well justify a glass factory, for which the raw materials are at hand, in several localities.

The clay deposits of Alabama, occurring in the same formations as in South Carolina, Georgia, Tennessee and Kentucky have been scarcely studied at all. Hitherto only the commoner and least valuable products have been made from them. There is every reason to believe that the future will see their utilization for the making of the higher priced products now characteristic of New Jersey and Ohio. The presence of cheap fuel is a primary advantage in this.

There is but one small soap factory in the state, although much cotton seed and peanut oils are sent to make soap in other states.

THIS survey of the chemical manufacturing industries of the state discloses rather plainly that with one conspicuous exception only those industries are represented that owe their presence to imperative necessity, e.g., sulphuric acid must be made to satisfy the fertilizer, the iron and steel and the explosive plants, while portland cement cannot stand heavy freight charges. In addition, traditional and standard methods of operation have been almost invariably used.

Whether or not this is to the credit of those interested and concerned in chemical production locally is open to discussion. The conspicuous exception is of course the Federal Phosphorus Company which has built up a flourishing industry under new patents, making many new products, and marketing them at considerable distances.

Raw materials, climate, soil, and other gifts of nature after all play a minor part in the upbuilding of a city, state, or country. The energy, tenacity, and knowledge of its people are much more potent in promoting its welfare. It is not irrelevant therefore in this study of local chemical progress, to mention that the state of Alabama has recently committed itself to a very ambitious and expensive program of education, from the primary schools to the graduate colleges, a program which should make its influence felt in chemical development as in all other fields of human activity.

Natural Resources and Manufactures of Western Pennsylvania

By W. A. Hamor and A. S. Keller

Assistant Director, Mellon Institute of Industrial Research, University of Pittsburgh

Secretary, Natural Resources Division, Chamber of Commerce, Pittsburgh

EDITOR'S NOTE. *In the July issue of* Chem & Met. *the authors discussed the natural resources of Western Pennsylvania in relation to the present status and future development of chemical industries. The following article deals with the chemical producing and consuming industries of the Pittsburgh district and the counties of Western Pennsylvania.*

PITTSBURGH's industrial district produces nearly 25 per cent of the country's iron and steel. In fact, the yearly output of its mills, blast-furnaces, and foundries amounts to over three-quarter billion dollars, and 100,000 men are employed in its steel mills.

The production of pig iron in the Pittsburgh industrial district gives employment to more than 7,000 persons, who are paid $13,500,000 annually in salaries and wages. The annual output of pig iron is 8,500,000 gross tons, which is more than one-fifth of the total production of the United States. The 57 blast-furnaces in and about Pittsburgh represent a capital investment of over $130,000,000. They consume annually 28,500,000 tons of raw materials, including 14,500,000 tons of iron ore from other districts (21 per cent of the ore mined in the United States) and almost 9,000,000 tons of coke, all made in the Pittsburgh district (one-fifth of the nation's total annual coke production).

The glass industry is one of the most important in the Pittsburgh industrial district, 46 factories producing window glass, plate glass, lighting glass, and numerous other forms of glassware. The total annual output is valued at fifty million dollars, and there are employed more than 12,500 workmen at a total annual payroll of over $17,000,000.

Pittsburgh occupies a dominant position in the manufacture of face brick, refractories, and similar ceramic products. The normal monthly capacity of the plants in this section has been estimated to be approximately 20,000,000 nine-inch bricks. The bulk of ordinary and special brick production in western Pennsylvania has an annual value of $15,648,000; this, taken together with other products manufactured from fire clay, gives a total ceramic products output of about $20,000,000 a year.

Year by year the annual value of electrical equipment manufactured in the district has increased, now exceeding $200,000,000 yearly. Besides electrical utensils for the household, there are produced electrical machinery, dynamos, transformers, motors, and turbine engines; while in the new branch of radio-equipment manufacture a leading position is held, mainly because of the research activities of the Westinghouse Electric and Manufacturing Co. This organization occupies more than 100 acres of floor space and employs 35,000 people.

While the production of coal and coke, the manufacture of iron and steel, their products, electrical and railroad equipment, glass and glassware, and brick and fire-clay products, constitute the real strength of the high industrial position of the Pittsburgh district, there are many other branches of manufacture which have attained national prominence. Some of these industries have sprung directly from chemical research, while others of them have been and are being nurtured by it.

The Chamber of Commerce of Pittsburgh has reported that there are 300 lines of manufacture in and about Pittsburgh, most of them of a ferro-metallurgical character, but many being uniquely different. It is worthy of note here that the district leads the world in the production of finished aluminum, has the largest food-packing plant in the world, and the greatest cork-products manufacturing plant.

The annual production value of the Pittsburgh industrial district exceeds $2,000,000,000 and the yearly value of the products of the purely diversified industries amounts to about $200,000,000.

Iron and steel are manufactured in 51 communities, glass products in 28, clay products in 16, chemicals in 14, machinery and tools in 12, enameled ware in 11, non-ferrous metals in 9, railroad equipment in 8, tin and terne plate in 7, electrical equipment in 5, and paint and varnish in 4 communities.

Production of Chemicals. The annual output of heavy chemicals in the Pittsburgh industrial district is valued at $10,000,000. The most important of these products, sulphuric acid, is manufactured in four plants in the district, and two-thirds of this acid is used in Pennsylvania, principally in the metropolitan Pittsburgh area. It is utilized in greater Pittsburgh in the processing of iron and steel, non-ferrous metals, textiles, fertilizers, petroleum products, paper, and pharmaceuticals, and in the production of ammonium sulphate. Hydrochloric and hydrofluoric acids are also made in quantity, the former largely for metallurgical purposes and the latter for etching glass. All the sulphuric, hydrochloric and hydrofluoric acids used in the Pittsburgh industrial district are produced therein. The nitric acid consumed, which is relatively small in quantity, is shipped in from outside points.

In the industrial district, in addition to the employees of the byproduct coke-oven plants, about 3,000 workmen are engaged at other factories making chemicals. In the whole area industries dependent on chemicals or chemical processes for their operations or the quality of their products employ over 200,000 persons. Greater Pittsburgh's industries using chemicals or chemical processes manufacture 85 different million-dollar products annually, and these products exceed one and a half billion dollars in total annual value.

The history of chemical technology in the Pittsburgh district is an informative demonstration of the material value of chemistry. Indeed, chemical research carried out in the district has given new industries of economic importance, as several examples will show.

The manufacture of bromine was begun in the United States in 1845 by David Alter, of Freeport, Pa., in partnership with Edward and James Gillespie. Alter was a physician of investigational resourcefulness who also conducted original research in spectroscopy and devised a commercially successful process for the destructive distillation of bituminous minerals. In 1866 works for producing bromine were erected at Tarentum, Pa., and in the following year Alter secured patent protection for his retort and process of obtaining bromine and iodine from bittern. In 1887 Francis C. Phillips, then professor of chemistry in the Western University of Pennsylvania, effected technically valuable improvements in manufacturing bromine and iodine, and his process was adopted by a company operating in Allegheny.

The pioneer work of S. M. Kier, a pharmacist of Pittsburgh, in distilling crude petroleum also deserves brief notice here. Kier began about 1855 to "refine" crude oil from a Tarentum brine well, using a still which he constructed. The "light, wine-colored" distillate which first came over was found useful for illuminating purposes as "carbon oil," while the heavier product was sold for cleaning wools. Kier adopted the Downer process of refining in 1860, obtaining more satisfactory results. Unlike Silliman's classical investigaton of crude petroleum, Kier's independent work was not systematic, but it gave some information on the economic value of crude oil. In 1859 there were six "coal oil" plants near Pittsburgh, but most of them were converted into petroleum refineries soon after Drake demonstrated that petroleum could be secured by drilling.

The bringing of aluminum into the rank of the cheaper metals is looked upon generally as one of the foremost metallurgical achievements of the nineteenth century, and the historian of technology classes the industrial

Industries of the Western Pennsylvanian Counties

County	County Seat	Miles from Pittsburgh	Industrial Statistics
Allegheny	Pittsburgh	0	The capital invested in 1924 in the mining and manufacturing industries of this most important county was $1,070,794,500, with a total value of production of $1,535,131,900. The outstanding classes of industry were primary metals, $835,660,700; secondary metals, $362,211,300; and food and kindred products, $112,977,900. These branches of manufacture have been described in a preceding section of this paper, which deals specifically with the immediate Pittsburgh district.
Armstrong	Kittanning	35	The mineral resources include petroleum and natural gas. The development of the manufacturing interests has been encouraging, the combined capital invested in 1924 being $38,734,100, with a total value of production of $43,428,400. The important classes of industry were clay, glass and stone products, $17,406,900; iron and steel products, $13,748,900; and coal and limestone, $8,556,200.
Beaver	Beaver	25	Beaver County has rich mineral wealth, the chief products being bituminous and cannel coal of good quality. These have aided to promote the technologic interest, and manufacturers are constantly becoming more important. In 1924 the combined capital invested was $159,095,500, with a total value of production of $188,747,600. The leading industrial classes were primary iron and steel products, $94,609,400; secondary metals, $70,016,800; and clay, glass and stone products, $7,483,500.
Bedford	Bedford	85	Because of Bedford County's fine forests and much iron ore the manufacture of iron was formerly a leading industry, but in recent years coal mining is one of the main occupations. The development of the manufacturing interests has been marked, the combined capital invested in 1924 being $5,003,300, with a total value of production of $3,627,800. The outstanding classes of industry were primary iron products, $1,218,600; coal and crushed stone, $740,000; and food and related products, $566,600.
Blair	Hollidaysburg	90	Blair County has an abundance of firebrick clay and ganister rock of superior quality; there are also limestone valleys. Considerable efforts have been put forth in the way of manufacturing, the combined capital invested in 1924 being $32,151,300, with a total value of production of $42,275,100. The outstanding industrial branches were iron and steel products, $15,760,800; paper, $11,278,200; and food and kindred products, $6,303,700.
Butler	Butler	30	Butler County has rich mineral resources, the principal ones being bituminous coal, iron ore, limestone, salt, petroleum and natural gas. These elements have encouraged a variety of manufactures, the combined capital invested in 1924 being $43,929,200, with a total value of production of $56,924,400. The most important industrial classes were iron and steel products (secondary), $34,871,000; petroleum products, $7,906,900; and clay, glass and stone products, $4,301,300.
Cambria	Ebensburg	70	Johnstown, the chief commercial site of Cambria County, has large steel manufactories, which have been helped into prominence by the coal and limestone with which the county is richly endowed. The capital invested in manufacturing amounted to $97,300,200 in 1924, and the total value of production was $229,343,200. The leading branches of industry were metals and metal products, primary, $135,230,700; mines and quarries, $40,056,900; metals and metal products, secondary, $32,564,300.
Cameron	Emporium	120	The capital invested in manufacturing in 1924 was $3,892,900, with a total value of production of $3,271,800. The principal classes of industry were powder and other explosives, $1,735,800; sole leather, $825,000; and pig iron and iron castings, $620,700.
Clarion	Clarion	65	Clarion County has much mineral wealth, bituminous coal, petroleum, natural gas, glass sand, and clay abounding. In 1924 the capital invested in manufacturing was $7,362,000, with a total value of production of $6,931,800. The main classes of industry were coal, $2,360,800; clay, glass, and stone products, $2,032,200; and petroleum products, $1,162,800.
Clearfield	Clearfield	95	Clearfield County has great mineral wealth, especially of excellent bituminous coal, which is being developed extensively. Some iron ore exists and deposits of superior fire-brick clay, limestone, shale rock and glass sand abound. The capital invested in manufacturing was $50,820,300 in 1924, with a total production value of $29,125,500. The outstanding classes of industry were mines and quarries, $11,665,800; clay, glass and stone products, $8,300,000; and sole leather, $2,613,800.
Crawford	Meadville	85	In 1924 the capital invested in manufacturing was $14,288,000, with a total production value of $18,302,600. The most important classes of industry were iron and steel products, $9,406,400; petroleum products, $3,801,500; and food and kindred products (especially dairy products), $3,098,300.
Elk	Ridgway	95	Formerly the timber products of Elk County, including tannery products, constituted the outstanding industry, but bituminous coal is now extensively mined. There is fireclay of good quality, and natural gas. In 1924 the capital invested in manufacturing was $42,830,600, with a total production value of $32,286,100. The main industrial branches were paper, $8,623,100; clay and glass products, $6,594,900; and sole leather, $6,291,600.
Erie	Erie	120	The capital invested in manufacturing in 1924 was $92,519,600, with

production of aluminum alongside the invention of Bessemer steel. Charles M. Hall, a chemist, took a metallic rarity and made out of it a common metal, and made the entire human race his debtor. The commercial development of the Hall process was begun in 1888 on Smallman Street, Pittsburgh, and the manufacture of aluminum became a business success at New Kensington, Pa. Since then the progress has been wonderful, and chemistry has been the pathfinder.

Another instance is the discovery of silicon carbide by E. G. Acheson. Acheson first produced carborundum in March, 1891, at Monongahela City, Pa., and began its manufacture in a small way. For the first six months his production amounted to about one-fourth pound per day; but the preliminary manufacturing experimentation proving encouraging, a company was organized, and in 1894 industrial operations were transferred to Niagara Falls.

And then there is radium, Pittsburgh's great gift to American medicine. The commercial production of radium preparations was begun in the United States by the Standard Chemical Co. of Pittsburgh, in 1913.

Certain nationally important industries have also been richly benefited by chemical research conducted in the Pittsburgh district. It is, for example, quite difficult to recall a more far-reaching invention than that of the dry air-blast for the manufacture of iron, devised by James Gayley, a metallurgical chemist. This discovery effected a reduction of from $0.50 to $1.00 per ton in the cost of producing pig iron, besides making it possible for the ironmaster to produce, in all weathers, a metal of uniform quality. The dry air-blast was developed by Gayley between 1885 and 1904 at the Edgar Thomson and Isabella furnaces in Pittsburgh, and between 1894 and 1911 he received no less than fifteen successive patents in this country.

The economic application of chemistry to construction, production and useful accomplishment, as exemplified in the history of Pittsburgh industries, has been a great gain both for science and technology.

Industries of Western Pennsylvania Counties (Continued)

County	County Seat	Miles from Pittsburgh	Industrial Statistics
Erie (cont'd.)			a total production value of $119,238,500. The outstanding classes of industry were metals and metal products (mainly brass, bronze, iron and steel products), $73,325,500; paper and printing (principally stationery paper) $13,892,800; and food and allied products, $8,938,300. Erie is a city of commercial importance that has the promise of more greatness because of its transportation and industrial strength.
Fayette	Uniontown	40	Fayette County has become famous as the producer of some of the best coking-coal in the country and has natural gas in abundance. Their development has created wealth and importance for many thriving localities, especially Uniontown, Connellsville and Brownsville. The capital invested in manufacturing amounted to $83,036,400 in 1924, with a total value of production of $92,994,800. The outstanding classes of industry were mines and quarries, $56,261,100; and metals and metal products, secondary, $3,339,000.
Forest	Tionesta	75	After having extensive lumber operations, other industries were developed, the county having coal, petroleum, natural gas, shale for brick-making and glass sand. The capital invested in manufacturing was $5,771,800 in 1924, with a total production value of $1,530,700. The prominent classes of industry were lumber and timber products, $971,100; and wood chemicals and petroleum products, $442,700.
Greene	Waynesburg	40	Greene County has fine coal lands, whose products make excellent coke, and natural gas and petroleum also contribute to the wealth of the Waynesburg region, which is being rapidly developed. The capital invested in manufacturing was $23,473,100 in 1924, with a total production value of $8,803,700. The principal classes of industry were coal, $7,311,200; and petroleum products, $1,078,200.
Indiana	Indiana	50	This large county is rich in mineral wealth, about one-half its surface being underlaid with good coal. Over one hundred mining operations are carried on. Natural gas is produced and there are salt springs. The capital invested in manufacturing was $47,946,600 in 1924, with a total value of production amounting to $24,862,500. The outstanding classes of industry were coal, $16,280,200; and clay and glass products, $2,146,700.
Jefferson	Brookville	70	Jefferson County has an abundance of coal and many mill-seats can be found. The capital invested in manufacturing in 1924 was $15,803,100, with a total production value of $12,393,000. Among the important classes of industry were coal, $6,385,500; and clay and glass products, $1,057,300.
Lawrence	New Castle	45	This county has large manufacturing interests, especially in New Castle and Ellwood City. The capital invested in manufacturing in 1924 was $51,557,200, with a total value of production of $119,418,400. The outstanding classes of industry were iron and steel products, primary, $82,287,800; secondary, $15,272,500; and building brick, artificial stone, portland cement, lime, and refractories, $11,162,200.
McKean	Smethport	125	For many years lumbering was the chief occupation in McKean County, but petroleum and natural gas have encouraged varied manufacturing. The total amount of capital invested in industries in 1924 was $45,473,400, with a production valued at $35,139,800. The main industrial classes were wood chemicals, petroleum products, etc., $16,692,200; clay and glass products, $6,381,300; and leather, $4,667,000.
Mercer	Mercer	60	Manufacturing is progressing in Mercer County, the amount of capital invested in 1924 being $93,703,600 and the value of production $112,694,100. The principal industry was iron and steel; primary products, $76,705,200; secondary, $29,912,800.
Somerset	Somerset	60	In 1924 the capital invested in manufacturing was $26,643,700, and the value of production $19,790,700. The value of the coal mined was over $18,000,000.
Venango	Franklin	65	Venango County has bituminous coal deposits in its southern parts, but owes its development mainly to the petroleum industry. In 1924 the capital invested in manufacturing was $72,305,800 and the value of production $43,609,800. The valuation of the petroleum products was $26,690,200; $7,591,700 worth of iron and steel products (secondary) were also marketed.
Warren	Warren	110	The capital invested in manufacturing was $29,590,500 and the value of production $30,919,300. The principal classes of industry were petroleum products, mineral acids and wood chemicals, $14,846,700; lumber and timber products, $8,322,200; and iron and steel products, $3,625,200.
Washington	Washington	25	Manufacturing holds an important place in the activities of Washington County, the invested capital being $115,154,400 and the value of production $149,468,900 in 1924. The outstanding classes of industry during that year were metals (zinc, ferro-alloys, and iron and steel products), $68,908,200; coal, $38,432,600; and clay, glass and stone products, $16,469,800.
Westmoreland	Greensburg	30	The development of the coal industry of Westmoreland County has made it one of the great counties of Pennsylvania. The capital invested in manufacturing was $201,134,900 and the value of production $210,989,100 in 1924. The most important industrial classes were metals and metal products (iron and steel, vanadium alloys, and aluminum products), $127,673,300; and coal, sand, and crushed stone, $ [illegible],005,900.

CHEMICAL ENGINEER'S BOOKSHELF

An American Rayon Literature

THE RAYON INDUSTRY. By *Mois H. Avram.* D. Van Nostrand Company, New York. 622 pp., 170 text figures and photographs. Price $10.

ACETATE SILK AND ITS DYES. By *Charles E. Mullin.* With a foreword by *Louis A. Olney.* D. Van Nostrand Company, New York. 472 pp. Price $6.

With the remarkably rapid growth of the American rayon industry to a position of world leadership within a period of less than ten years, there has been an urgent demand for an adequate literature of the technology and economics of this development. Naturally the journal literature was the first to be developed and the past few years have witnessed an unusually large number of articles and discussions of nearly every phase of the rayon industry. To revise and correlate these into more permanent form and to fill in the natural gaps has been the task confronting the American technologist. And judging from the character of these two most recent volumes, the work is being creditably done with progress comparable to the phenomenal advance that has been made by the industry itself.

Mr. Avram, an experienced engineering consultant, has given us the first complete book devoted solely to rayon—a most comprehensive industrial report from the economic, financial, engineering, production and commercial phases of the subject. As such it is equally interesting to the engineer, the banker, the manufacturer and user of the product.

More specific in its treatment, Mr. Mullin's book limits its attention to acetate silk, dealing largely with the interesting and peculiar dyeing properties of this product. Important technical progress has been made in this field during the past five years, and Mr. Mullin, as a thoroughly trained textile chemist, has clearly and accurately presented this information for the practical user of acetate silk. The book is largely but not entirely based on the author's recent articles appearing in the *American Dyestuff Reporter,* the *Textile Colorist* and the *Canadian Colorist and Textile Processor.*

* * * *

VAN NOSTRAND'S CHEMICAL ANNUAL. Edited by *John C. Olsen;* assistant editor *T. R. Le Compte.* Sixth Issue. D. Van Nostrand Company, New York. 882 pp. Price $5.

It has been eighteen years since the first issue of this compilation made its appearance and in the six editions and various reprintings since that time, the volume has grown progressively in size and usefulness to the chemist. In the present revision all molecular weights have been recalculated in accordance with the 1925 international values, and new tables have been added on isotopes, p^H and hydrogen values, specific gravities and other properties of proteins, and physical properties of lead and mercury. In general the Chemical Annual is keeping step with advances in chemical science.

* * * *

TITANIUM, with special reference to the Analysis of Titaniferous Substances. By *William M. Thornton, Jr.* American Chemical Society Monograph Series. Chemical Catalog Company, Inc. New York. 262 pp. Price $5.

Although dealing briefly with the occurrence, general chemistry and industrial applications of titanium, the major portion of this monograph is given over to analytical methods in the detection and estimation of the element. As such this book is of principal interest to the metallurgical analyst.

* * * *

SOAP AND GLYCERINE MANUFACTURE. A modern treatise on the production of soaps of all kinds and on the recovery and distillation of glycerine. By *E. T. Webb.* Davis Bros., London. 244 pp. Price 25 shillings.

Expanding and supplementing information previously published by Mr. Webb in a series of articles appearing in the *Chemical Trade Journal and Chemical Engineer* during 1925, the author has produced a book essentially practical in nature and therefore likely to be of unusual interest to the soap and glycerine industry. He publishes for the first time, it is stated, the exact quantitative relationship of the mixtures of oils, fats and chemicals used in soap production. Similar quantitative data are given for steam consumption, yields, losses in glycerine recovery, etc. Discussion of equipment is limited to a comparatively few outstanding examples of efficient and successful operation.

* * * *

PETROLEUM DEVELOPMENT AND TECHNOLOGY IN 1926. Papers presented before the Petroleum Division, A.I.M.E. at Tulsa, Oklahoma, October 11-12, 1926, and New York, February 15-17, 1927. Published by the American Institute of Mining and Metallurgical Engineers, Inc., New York. 956 pp. Price $6.

For the past four years it has been the practice of the Petroleum Division of the A.I.M.E. to collect and publish in permanent form the various papers presented before the meetings of the Society. The present volume contains seventy-three papers with attendant discussions, as well as a digest of round-table discussions on petroleum engineering, education and research. Papers on production engineering account for 358 pages and on refining technology there are 80 pages with an additional 165 pages on the corrosion symposium. Petroleum economics, production and the two round-table discussions account for the remainder of the volume.

The information thus made available to technologists in the oil industry is indeed comprehensive, yet the reader who consults the volume for specific data is likely to join with the retiring chairman of the division in stressing "the need of authors giving consideration to an avoidance of old material and unnecessary generalization."

* * * *

Motor Fuels and Engine Design

THE RELATION OF MOTOR FUEL CHARACTERISTICS TO ENGINE PERFORMANCE. By *George Granger Brown,* assistant professor of chemical engineering, University of Michigan; director of research, Association of Natural Gasoline Manufacturers. Published by the University of Michigan, Ann Arbor, Mich. 127 pp. Price $1.

As a study of the functioning of available automotive fuels in the present designs of automotive engines, this work is commendable. Under the two heads of volatility and anti-knock properties, summaries of laboratory and road tests are made and specifications are given for fuels having the desired qualities to meet different conditions.

Methods are also proposed for blending and treating fuels to give these qualities.

The weakness of this study is that, as in most similar studies that have been made recently, no account is taken of the possibilities of changes in engine design. The fact is that the present design of automotive engine was developed for a grade of fuel no longer generally obtainable. Instead of going to great effort and expense to blend and doctor fuels to fit the engine, investigators such as the present author would be better advised to work toward fitting the engine to the available fuel. That this can be done is common knowledge among mechanical engineers, particularly in Europe. That it be done eventually even in the United States is greatly to be desired.

* * * *

A Handbook of Kinetic Theory

KINETIC THEORY OF GASES. By *Leonard B. Loeb.* McGraw-Hill Book Company, Inc., New York. 555 pp. Price $5.50.

Reviewed by E. D. RIES

THOSE who in the past wished to make use of the kinetic theory found themselves severely handicapped by the lack of a text which brought together in a readily understandable but quantitative form the results of the many workers in this field. Material was published in many different journals and most texts in existence were advanced in character and usually written in foreign language. The student generally had to have a working knowledge of the theory before he could use the texts. The appearance of Loeb's book therefore fills a long-felt need for a complete and authoritative English text on the subject.

The book is arranged so that the various concepts are developed as independently as possible. Each concept is introduced in simple form. This is followed by an elementary derivation which gives the reader a good picture of the mechanism without confusing him with too much mathematical detail. As inaccuracies in the elementary theory become apparent a more advanced derivation takes care of them, in some cases followed by the most recent developments available. Experimental work is usually tied in with the theory. A good bibliography including references to original work is included at the end of each chapter.

In addition to the usual classical derivations, there are three new branches studied in detail. The first of these is a complete chapter giving a summary and discussion of the kinetic theory of low-pressure phenomena. The second and third constitute applications of the theory to dielectric and magnetic phenomena in gases, and to gaseous ionization.

The book will find uses in many fields. It serves as a handbook for students of kinetic theory and also as a preparation for further work in advanced texts and monographs. This admittedly is a rather limited field. However, it is of the greatest value in all fields of applied science since it furnishes those not well acquainted with the theory a means of using and understanding its applications without spending the large amount of time heretofore involved in a study of the literature. The beauties of kinetic theory methods are immediately evident from the elementary derivations; and the more advanced student can appreciate the way in which refinements are introduced in the later mathematical discussions.

Appendices in the back furnish valuable information in the way of a tabulation of fundamental data on molecular diameters, velocities, mean free paths and so on.

The make-up of the book is up to the usual high standard of American publishers, the errors very few, and the index good. It is recommended to all scientists as a valuable addition to their libraries.

* * * *

Methods of Analysis of Coal

METHODS OF ANALYSIS OF COAL. 35 pp. Fuel Research Board, Department of Scientific and Industrial Research. H. M. Stationery Office, London. Price 9 pence (18 cents).

Reviewed by W. A. SELVIG

THIS publication gives standardized methods for analyzing and testing coal as adopted by the British Fuel Research Board. It includes methods for proximate analysis, ultimate analysis, calorific value, phosphorus, carbonates, caking index, and laboratory carbonization assay.

As many of the determinations made in analyzing coal are empirical, carefully standardized methods must be used if the results obtained by different analysts are to be comparable. Much confusion has resulted from the use of different methods of coal analysis, especially for such empirical methods as are used for the proximate analysis. For the classification of coal, specifications for the purchase of coal, and for the economical utilization of coal, standard methods of analysis are essential. The British methods for proximate and ultimate analysis and for calorific value are so similar to the standard American methods that the results obtained by either should be virtually identical.

In the form of reporting ultimate analyses of as-received coals, the British practice differs from the American in that the former report the moisture of the coal as a separate item and do not include the hydrogen and oxygen of the moisture with that of the coal substance. The customary American practice of reporting ultimate analyses of as-received coals includes the hydrogen and oxygen present in the moisture with the hydrogen and oxygen of the coal substance.

A method for determination of caking index is given. This determination is necessarily empirical and the value of the test will depend upon its co-ordination with use properties of various coals.

Two methods are given for making laboratory carbonization assays of coal to obtain information as to the gaseous and liquid products that might be expected from large-scale operations. Apparently the value of such tests largely depends upon the facilities available for correlating the laboratory results with those obtained in practice and the application of proper factors to the laboratory results.

* * * *

The Aristocracy of Science

OLD CHEMISTRIES. By *Edgar Fahs Smith.* McGraw-Hill Book Company, Inc., New York. 89 pp. Price $2.50.

Reviewed by ELLWOOD HENDRICK

IN EVERY RESPECT in the writing, the publishing and the making, this book has been a labor of love. Dr. Smith wrote it because he couldn't help himself: with all those old tomes in his famous library, with his ardent love for them and the fear lest they be neglected or forgotten,—he just *had* to write it! And the last thing in the world that the good Provost Emeritus of Pennsy thinks of in any connection is profit to himself. The

publishers are alive to the temper of their day and generation, and it stands to reason that they did not sense any audible public demand for a book on old chemistries. The writer "happens to know" because an officer of the corporation told him that they issued the work because they felt it to be right and proper that it be done, and with no thought of putting forth a "best-seller." In the letter-press, paper, binding and the copious illustrations they have made a book of distinction and beauty.

We shall not attempt to express any opinion of the author. What American chemists think of Edgar Fahs Smith he is too modest to guess and we do not propose to enlighten him. But what the genial Doctor thinks of American chemists he has been telling for years in acts, in spoken words, in books and in pamphlets. To him we are most engaging, the most entertaining, and in the social sense, the most desirable of all men.

His text and his quotations support the same view of chemists of earlier days. From John French's "Art of Distillation," published in 1653, we read: "Court the mother, and you winne the daughter; prevail with Nature and the fair Diana of the Philosopher is at your service." That is the keynote to the book: chemistry is never a mere job; it is the outstanding profession of a gentleman and a scholar in philosophy.

It is so full of leads for the man who loves his profession that it is hard to discriminate in pointing them out. Of etymological significance is the title of a chapter in Thibaut's "Cours de Chymie," published in 1667, which reads "De l'Elaboratoire Chymique." Interesting, too, is the thought of Tobern Bergmann's "Aerial Acid." There's a touch of romance in the record of Richard Watson, Bishop of Llandaff, who, recognizing the burden of his episcopal duties, tried again and again to tear himself loose from his laboratory. But, he declared, *"veteris vestigia flammae* still continued to delight me and at length seduced me from my purpose."

The conquest of the phlogiston theory was a battle royal, which is admirably brought out in the references to Lavoisier, Foureroy, Joseph Black and the American group. Lavoisier's letter to Franklin about it is given in full. The idea of combustion as we consider it today was then called French chemistry and it became almost a political issue. Washington tried diligently to induce Count Chaptel to come to the United States to develop the science in this country.

These are mere hints of the fascinating contents of the book. It is unnecessary to tell American chemists of the author's scholarship as well as of the charm and extraordinary grace of his style. Any chemist is bound to feel himself in very distinguished society as he follows the pages on which all the scenes are laid within his own profession.

* * * *

Chemical Progress in Gas Industry

REPORT OF CHEMICAL COMMITTEE—1926, of American Gas Association, *A. C. Fieldner*, Chairman. Published by the Association. Available paper bound, $1.50 per copy or in the form of separate chapters, 25 cents to 35 cents each.

"RECENT progress in science in relation to the gas industry" was summarized by seventeen chapters which make up the report of the Chemical Committee of the American Gas Association for the year 1926. This committee effort was undertaken in order that the industry might have conveniently brought together in a brief document outstanding developments in science and technology that affect any branch of the business. The seventeen chapters and their authors are: 1. The Constitution of Coal, by Jerome J. Morgan; 2. Physical and Chemical Properties of Coke in Relation to its Manufacture and Use, by A. R. Powell; 3. Coal Carbonization and the Chemical and Physical Properties of Coking Coals, by Harold J. Rose; 4. Water-Gas Manufacture, by W. H. Fulweiler; 5. Complete Gasification of Coal—The Use of Oxygen for Gas Making, by R. S. McBride; 6. New Processes of Interest to the Gas Industry, by R. T. Haslam; 7. The Cleaning of Combustible Gases with the Cottrell Electrical Precipitation Processes, by N. W. Sultzer; 8. Tar Refining and Tar Products, by John Morris Weiss; 9. Light Oil Recovery and Refining, by E. F. Pohlmann; 10. The Recovery of By-Products other than Tar, Ammonia, and Light Oil, by Harry A. Curtis; 11. Gas Purification, by F. W. Sperr, Jr.; 12. Corrosion, by Wilbert J. Huff; 13. Materials of Construction, by John F. Anthes; 14. Blending Natural and Manufactured Gas, by C. J. Wright; 15. The Recovery of Waste Heat in Gas Manufacture, by E. L. Hall; 16. Analytical Methods and Tests, by A. F. Kunberger; 17. Application of Physical and Physico-Chemical Research to Control Measurements in Gas Manufacture, by S. P. Burke.

Any one whose scientific or engineering work requires attention to any of these subjects will find the pertinent chapters in this report an excellent basis for beginning any studies. Each chapter has been written by a specialist thoroughly acquainted with his subject and no effort was made to present all confusing detail. The policy was, rather, to make a critical digest of the best available information on each topic treated.

* * * *

Equilibra in Saturated Salt Solutions

EQUILIBRIA IN SATURATED SALT SOLUTIONS. By *Walter Charles Blasdale*. American Chemical Society Monograph Series. The Chemical Catalog Company, Inc., New York. A Summary of the Results of the Study of the Heterogeneous Equilibria Which Exist in Aqueous Solutions of Electrolytes. 197 pp. Price $4.50.

Reviewed by W. L. MCCABE

This volume gives for the first time in English a well organized treatment of the phase equilibria relationships of aqueous salt solutions. The basis of the technology of the separation of the components of naturally occurring salt mixtures depends on such relationships and Professor Blasdale's treatment will be a welcome addition to the literature of industrial chemistry as well as to theoretical physical chemistry.

To quote from the introduction, "No new ideas should be looked for in this volume. The fundamental features of the subject were discovered, for the most part, many years ago." The author has done his task of organizing the existing data into a coherent whole very well. For the size of the book there are included a large number of specific examples.

The text starts with a chapter on water, treated as a typical one-component system; then passes on to two-, three-, four-, five-, and finally six-component systems. The Strassfurt deposits are discussed in the chapters on five- and six-component systems.

The graphical methods used include those of Van't Hoff, D'Ans, and Jänecke as well as the ordinary types of temperature-concentration diagrams.

The style of presentation is terse, but there are no

gaps in the continuity. It is not a book to be read quickly, and the value per page is high. The diagrams, on which so much depend are clear and accurately lettered. In short, in a small space on the bookshelf one can have an accurate and completely organized treatment of equilibria in saturated salt solutions.

* * * *

Casein and Its Industrial Applications

CASEIN AND ITS INDUSTRIAL APPLICATIONS. By *Edwin Sutermeister* and nine contributing editors. American Chemical Society Monograph Series. Chemical Catalog Co., Inc., New York. Price $5.

Reviewed by A. W. ALLEN

THE industrial applications of casein are legion. In addition to the major uses in the manufacture of paint, paper, plastics and glue, it is a constituent of many medicines and foods. It is utilized, moreover, in the preparation of pastes, picture moldings, soap, shoe polish, photographic materials, oilcloth and linoleum, composition cork, paint removers, insecticide sprays, imitation leather, stenciling paint and colored micas; and for sash glazing, for reducing the flammability of celluloid and for solidifying mineral oils.

Ample justification exists, therefore, for the compilation of the treatise under review, which consists of sections on "Casein in Paper Making" and "Analysis and Testing of Casein" by E. Sutermeister; "Organic Chemistry of Casein" by R. A. Gortner; 'Physical Chemistry of Casein" by J. A. Wilson; "Manufacture of Casein" by A. O. Dahlberg; "Casein Paints" by A. H. Warth; "Casein Plastics" by G. H. Brother; "Casein Glues" by F. L. Browne; "Casein in Medicine" by P. Masucci; "Casein in Foods" by H. A. Schuette, and "Storage of Casein" by A. H. Warth. An additional chapter covers miscellaneous uses, statistics and bibliography. Thus it will be seen that the subject has been dealt with from every desirable angle—scientific, technical and industrial—by a group of chemists and engineers who are specialists. The result is to be commended, and the book can be recommended with confidence.

Incidentally, one is prompted to protest against the appalling weight of so many textbooks published in the United States. A five-foot bookshelf of volumes of the same type as 'Casein and its Industrial Applications" would turn the scales at about 120 lb. Is this abnormal weighting of the paper necessary or desirable? The resulting density makes it almost impossible for a traveling engineer to include in his baggage an adequate number of American textbooks.

* * * *

General Chemistry

GENERAL CHEMISTRY. A cultural course based on the texts of the late *Alexander Smith*. By *James Kendall*, professor of chemistry and administrative chairman of the department of chemistry, Washington Square College, New York University. The Century Company, New York. 676 pp. Price $3.50.

Reviewed by J. H. REEDY

This is the latest of the well-known Smith-Kendall series of textbooks on general chemistry. A cursory examination shows that it is an abridgement of the Smith-Kendall "Inorganic Chemistry," prepared, for the most part, by cutting out various paragraphs in this latter book.

The most distinctive feature of the book is the preface, in which the author states his purpose in preparing the book. He states that it was written for the average freshman, and not alone for those who expect to become "honest-to-goodness" chemists. He reminds us that the course in general chemistry as usually given does not inspire the student with a love for the science. "Unless compelled to proceed further, the student abandons the subject at the end of the term with a deep sign of relief. A few years later nothing more is remembered, in all probability, except that it was unreasonably stiff, that the smells in the laboratory were terrible, and the formula for water is H_2SO_4. The business man is occupied with other products than solubility products; his better half is vastly more interested in complexions than in complex ions." In order to humanize the course to a greater degree, the author has proceeded to "apply the knife" to a number of topics that are too technical and theoretical; e.g., the balancing of complex equations, the quantitative side of the mass law, and the less familiar elements and compounds. All the fundamental principles of the science have been retained, and the modern theories of atomic structure ionization, transmutation of elements, etc., have been well presented.

As would be expected of a book by Professor Kendall, the book is not only accurate and logical, but clever. It contains a large number of page illustrations, and in the last chapter (which he calls the "valedictory") he lists some of the leaders of modern chemistry and their particular achievements. An excellent list of reference books is included.

* * * *

THE IRON INDUSTRY IN PROSPERITY AND DEPRESSION. By *Homer Bews Vanderblue*, director of the Harvard Economic Service, professor of business economics, graduate school of business administration and *William Leonard Crum*, director of the statistical laboratory of the Harvard University Committee on Economic Research; assistant professor of statistics, Harvard University. A. W. Shaw Company, Chicago and New York. 193 pp. Price $7.50.

The authors have made a statistical analysis of prices and production of iron and steel, the regional production of pig iron, and have discussed forecasting conditions in the industry. The principal statistical series that are of help in forecasting are unfilled orders of the United States Steel Corp., the prices of the principal and intermediate and final products of the industry, and the prices of the stocks of the large steel-producing corporations. The book should be of wide interest, not only because of the specific data presented on the iron industry, but because of the statistical methods used.

* * * *

A COMPREHENSIVE TREATISE ON INORGANIC AND THEORETICAL CHEMISTRY. VOL. VII. By *J. W. Mellor*. Longmans, Green and Co., London, Toronto, Bombay, Calcutta and Madras. 977 pp. Price $20.

Volume VII of Mellor's treatise on inorganic and physical chemistry includes the following subjects: Titanium, Zirconium, Hafnium, Thorium, Germanium, Tin, Lead, and the Inert Gases. The editorial plan of previous volumes has been followed, and in every way Volume VII maintains the standards set for the series.

* * * *

THE GAS ENGINEER'S POCKETBOOK. By *Henry O'Connor*, revised by *A. T. Gilbert* and *H. B. Morris*. Fourth Edition. D. Van Nostrand Company, New York. 408 pp. Price $7.

This is the Fourth Edition, revised and enlarged, of O'Connor's well-known handbook for gas engineers. It is made up of tables, notes and general information useful to engineers in the coal-gas industry and in addition contains much general engineering data. It should be of much service to those for whom it is prepared.

Selections from Recent Literature

SULPHUR DIOXIDE. G. Weissenberger and H. Hadwiger. *Zeitschrift für angewandte Chemie*, June 23, pp. 734-6. In the application of methods used for recovery of volatile solvents to the recovery of industrial gases, several organic solvents were tried as absorption liquids for SO_2. Of the liquids tested, cyclohexanone was the best absorbent and tetralin the poorest. The absorption is promoted by certain catalysts, e. g. Hg.

MOLDED INSULATION. Sommerfeld. *Zeitschrift für angewandte Chemie*, June 23, pp. 744-5. A review of the raw materials, the uses to which their properties adapt them, and methods of making molded insulation.

SAFETY DEVICES. CHEMISCHE INDUSTRIE, June 25, Supplement, 24 pp. Report for 1926 of the Technical Superintendents. Industrial accidents of the year are reported and discussed in classified order. Accident prevention is considered, and numerous safety devices are described and illustrated. These include gas masks, non-slip ladder feet, belting and machinery guards, lamp guards, safety valves, etc.

SYNTHETIC RESINS. Herbert W. Rowell. *Chemistry and Industry*, June 24, pp. 573-7; July 1, pp. 593-8. A review of the manufacture, properties and uses of resins of the Bakelite, cumarone, carbamide, thiocarbamide and glyptal types. Illustrated.

CLEANING COAL. *Journal of the Society of Chemical Industry*, July 1, pp. 229-50T, July 8, p. 270-9T. Joint conference of the Fuel Section, S.C.I., with the Inst. of Gas Eng. and the Coke Oven Managers' Assoc. Papers were read by Chapman and Wheeler, on a comparison of methods of cleaning coal; by Guider on froth flotation applied to a Baum washer; and by Sinnatt on problems encountered in preparing coal for the market.

FIBROUS CELLULOSE. J. L. A. MacDonald. *Journal of the Society of Chemical Industry*, July 1, pp. 251-61T. A review of the making of esparto pulp and various kinds of wood pulp. By-product recovery and some essential economic factors in the success of the paper pulp industry are discussed.

NEW STORAGE BATTERY. Franz Jirsa. *Zeitschrift für Elektrochemie*, April, pp. 129-34. A new silver accumulator, Ag/OH′/Fe, is an improvement on the Ag/OH′/Cu accumulator patented by Jungner in 1899. The electrodes are made of Fe gauze; spongy Ag is pressed on for the anode, and a paste of Fe dust in gum arabic for the cathode. The gauzes are then dried and ignited. Mechanical strength is quite satisfactory. Electrical performance is shown in a series of curves.

WOOD PRESERVATION. H. Bechhold and E. Heymann. *Zeitschrift für Elektrochemie*, May, pp. 161-70. Illustrated description of the new electro-osmotic processes for freeing wood of mineral salts (de-ashing), and introducing fungicidal salts. Ashless wood does not swell readily and is less favorable to fungous growth than untreated wood. The penetration of fungicidal salts is not much better in the electro-osmotic process than in the Boucherie process.

BERYLLIUM. Johannes Becker. *Zeitschrift für Elektrochemie*, May, pp. 181-2. The Stock-Goldschmidt process of making beryllium has already greatly lowered the cost of the metal, and it may be expected that as the supply increases the demand will increase accordingly, so that large scale production and use will ultimately be feasible. As a lighter metal than aluminum, beryllium has some important properties from the technical standpoint; it is harder than glass, has a very high melting point and is malleable.

REFRACTIVE CRUCIBLE. M. K. Hoffmann. *Zeitschrift für Elektrochemie*, May, pp. 200-2. It has been found that the heat resistance of carbon crucibles can be greatly improved by heating them in an electric furnace with a colloidal solution of a carbide-forming oxide, perferably SiO_2 or V_2O_5. The treated crucibles will withstand a temperature of more than 2,000 deg. C. for a considerable time. The silica treatment is recommended for all melts which will not react with SiC.

ALCOHOL SOAPS. Richard Falck. *Zeitschrift für angewandte Chemie*, July 7, pp. 771-6. Alcohol soaps are particularly useful for disinfecting; and as bath soaps they combine detergent properties with the benefits of the alcohol rub. A well-made alcohol soap is thoroughly mixed, has high lathering power and melts above the b.p. of alcohol (in cake form) or has a firm, smooth consistency (in paste form). Recent improvements have been along the lines of soap quality, stability and packing for the market.

NAPHTHALENE. Georg Weissenberger. *Zeitschrift für angewandte Chemie*, July 7, p. 776. Coal gas, after scrubbing, contains 0.8 to 1 g. of naphthalene per cbm. To avoid depositing of the solid in pipes at winter temperatures there should not be more than 0.06 to 0.07 g. per cbm. Mixing with water gas for commercial use reduces the naphthalene content to about 0.5 g. per cbm. To test the practicability of numerous proposals for scrubbing out the residual naphthalene with a solvent, solubility curves were plotted from actual determinations. Tetralin is the best available solvent, decalin coming next. The solubilities in hexalin and methyl hexalin are rather low.

POTABLE WATERS. Haupt. *Zeitschrift für angewandte Chemie*, July 7, pp. 783-4. In making surface waters fit for drinking, the copper treatment is recommended for removing plankton organisms; chlorination for sterilizing, and aluminum clarification for removing turbidity and coloration. For a moderately good raw water these treatments are generally quite sufficient.

COAL. F. Fischer. *Zeitschrift für angewandte Chemie*, July 14, pp. 799-804. A lecture, reviewing the principal researches on the physical and chemical structure and constitution of coal; chemical derivatives obtained by oxidation and by hydrogenation; and the great possibilities in synthetic organic chemistry opened up by the production of cheap CO and H_2 from coal and steam.

CYANIDES. E. Elod and H. Nedelmann. *Zeitschrift für Elektrochemie*, June, pp. 217-36. A detailed study of the catalytic synthesis of HCN from NO and CH_4, C_2H_4 or C_2H_2. The mechanism of the reaction was investigated and the influence of temperature and other factors was measured. The yield of HCN increases with increasing temperature and time. Ethylene is preferred to methane or acetylene. The best catalyst was found to be a mixture of equal parts of quartz and Al_2O_3.

CHROMIUM PLATING. J. Stscherbakow and O. Essin. *Zeitschrift für Elektrochemie*, June, pp. 245-52. A good yield of Cr can be obtained only in presence of other anions in addition to CrO_4''. The yield is temporarily much improved by interrupting the current or by replacing the Cr plated cathode by an Fe cathode of the same size. For consistent high current yield in practice, colloid accumulations must be avoided either by a low current density or by stirring or by interrupting the current.

PROGRESS REPORTS. *Chemiker-Ztg.* "Fortschrittsberichte" Section, June 22. pp. 33-68. The reports are on Inorganic Chemical Industry, 1924-1926, by Bruno Waeser, with 515 literature citations; Dye Chemistry in 1926, by F. Mayer, with 157 literature citations; Synthetic Sweetening Agents, by Walter Herzog, with 47 literature citations.

DYEING SILK. Egon Elod. *Zeitschrift für angewandte Chemie*, June 16, pp. 692-3. When silk is weighted with tin, free stannic acid is deposited on the fiber. This deposit has a mordant effect with respect to some dyes; and the amount of dye absorbed by weighted silk is less than with unweighted, in accordance with the lower protein content of weighted silk. As would be expected, deaminized silk absorbs more of basic dyes and less of acid dyes than raw silk.

PROTECTIVE COATINGS. Wuerth. *Zeitschrift für angewandte Chemie*, June 16, p. 695. A brief review of the raw materials, manufacture and industrial importance of weather-proof, corrosion-proof and chemical resistant paints, varnishes and lacquers.

FERMENTS AND FERTILIZERS. F. Hayduck. *Zeitschrift für angewandte Chemie*, June 30, pp. 751-5. The newer applications of fermentation include silage technology and improved utiliza-

tion of soil bacteria; but one of the most significant developments, for the future of agriculture, is in the controlled fermentation of manures. It is expected that both the amount and efficiency of manure utilization will increase, without curtailing the use of chemical fertilizers. The latter are needed in addition to manure products.

BITUMENS. Stern. *Zeitschrift für angewandte Chemie,* June 30, pp. 761-2. A discussion of the properties of asphalts and the like, as related to their uses for paving, roofing, waterproofing and protective coatings.

CELLULOSE INDUSTRIES. C. J. J. Fox and L. Hall. *Journal of the Society of Chemical Industry,* July 8, pp. 281-4T. A review of recent advances in cellulose technology, including lacquers, artificial fibers, cellulose ethers and controlled processes of fermentation.

AMMONIUM CHLORIDE. Wilhelm Adolphi. *Chemiker-Zeitung,* June 29, pp. 489-91. Description of the saturation method of recovering ammonia as the chloride in gas works, and the sublimation method of refining the crude salt. The conversion of the sulphate to the chloride by treatment with an alkali chloride is generally not profitable, but sometimes local conditions are such that this method can be successfully operated. Illustrated.

AIR FLOATING. *Chemiker-Zeitung,* June 29, pp. 492-3. Illustrated description of the new "Atom" double current air floating separator of the Alpine Maschinen A.—G.— The fineness can be regulated at will, up to 3,000 meshes per sq.cm. There are no moving parts on the inside and cleaning is easy. Power consumption is only 1.5 to 3 hp.

FLUORIDE ENAMELS. G. Agde, H. F. Krause and W. M. Lehmann. *Zeitschrift für angewandte Chemie,* July 14, pp. 804-8. X-ray spectrograms have shown that the substance which causes turbidity in enamel when Al fluoride is added is NaF. When Ca fluoride is added, the turbidity is supplied by a variable mixture of Ca and Na fluorides. NaF can be used as such with satisfactory results. These findings confirm the results of microscopic studies.

MIRROR GLASS. A. Wendler. *Zeitschrift für angewandte Chemie,* July 14, pp. 823-4. An account of the Bicheroux method of pouring glass for mirrors. This is an ingenious method of handling an entire melt (1,000 liters) at one time, rolling it as thin as 6.5 mm.

TUNGSTEN ARC. Franz Skaupy. *Zeitschrift für angewandte Chemie,* July 14, p. 824. The tungsten arc has some advantages over the carbon arc for illumination, e.g. in projection lanterns, and in other cases where an intense but quietly burning light is desired. It is also suitable for some of the same uses as the mercury lamp, e.g. in medicine. It makes good substitute for sunlight for many testing purposes.

X-RAYS. Jean J. Trillat. *Chimie et Industrie,* June, pp. 883-98. A review of the nature and production of X-rays, and their uses. Industrial applications are classified according to whether they depend on ionization, diffraction or spectrographic analysis. Illustrated.

STORAGE BATTERIES. Chas. Fery. *Chimie et Industrie,* June, pp. 909-12. Theory of the lead accumulator; some needed improvements. The principal remedy against sulphatation is to protect the negative electrode from oxidation. The influence of porosity and of plate thickness is discussed.

ELECTROLYTIC CRYSTALLIZATION. V. Kohlschuetter et al. *Zeitschrift für Elektrochemie,* July, pp. 272-308. A detailed study of the form and state of aggregation of loose deposits of metals, and of the formation and properties of adherent deposits. The metals included in the study are: Pb, Cd, Zn, Sn, Ag, Tl, Ni, Cu, Co, Fe, Pd, Cr and certain mixtures. Allow formation is discussed. Illustrated.

RESINS. Joh. Scheiber. *Farbe und Lack,* July 6, pp. 364. Among the newer artificial resins derived from natural resins are Blumanil, made from soft Manila copal; refined dammar; Zellodammar; and b-resene, obtained as a by-product in making Zellodammar from dammar. Some of these are excellent varnish or lacquer resins.

Government Publications

Prices indicated are charged by the Superintendent of Documents, Washington, D. C., for pamphlets. Send cash or money order; stamps and personal checks not accepted. When no price is indicated, pamphlet is free and should be ordered from Bureau responsible for issue.

Technology and Uses of Silica and Sand, by W. M. Weigel. Bureau of Mines Bulletin 266. 40 cents.

The Ferric Sulphate-Sulphuric Acid Process, compiled by Oliver C. Ralston, with a chapter on Producing Small Bubbles of Gas in Liquids by Submerged Orifices, by Chas. G. Maier. Bureau of Mines Bulletin 260. 30 cents.

Drilling and Blasting in Open-Cut Copper Mines, by E. D. Gardner. Bureau of Mines Bulletin 273. 30 cents.

Precipitation of Lead and Copper from Solution on Sponge Iron, by G. L. Oldright and others. Bureau of Mines Serial 2812.

The Chromium Situation from a Domestic Standpoint, by J. W. Furness. Bureau of Mines Information Circular 6038.

Metallurgical Limestone, by Oliver Bowles. Bureau of Mines Information Circular 6041.

The Carbon Monoxide Self-Rescuer, by A. C. Fieldner, S. H. Katz, and D. A. Reynolds. Bureau of Mines Serial 2591, revised April, 1927. 5 cents.

Mica, by W. M. Myers. Bureau of Mines Information Circular 6044.

Fatalities in the California Petroleum Industry During the Calendar Year 1926, by H. C. Miller. Bureau of Mines Serial 2814.

Petroleum Refineries in Foreign Countries, Based on Reports of Consular Officers of the Department of State and Oversea Representatices of the Department of Commerce, compiled by John H. Nelson. Bureau of Foreign and Domestic Commerce Trade Information Bulletin 494. 10 cents.

The Suitability of American Woods for Paper Pulp, by Sidney D. Wells and others. Department of Agriculture Department Bulletin 1485. 20 cents.

U. S. Government Master Specifications on the following materials, issued under Bureau of Standards Circular numbers indicated. No. 94, Black Paint, Semipaste and Ready Mixed, 3d edition; No. 331, Chrome Yellow (Lemon, Medium, and Orange; Dry, Paste in Oil, and Paste in Japan). 5 cents each.

Electrodeposition of Chromium from Chromic Acid Baths, by H. E. Haring and W. P. Barrows. Bureau of Standards Technologic Paper 346. 15 cents.

Ceramic Properties of Some White-Burning Clays of the Eastern United States. Bureau of Standards Circular 325. 20 cents.

Packing for Domestic Shipment, a group of publications in the Domestic Commerce Series of the Bureau of Foreign and Domestic Commerce, as follows: No. 10, Fiber Containers; No. 11, Cleated Plywood Boxes; No. 12, Wire-Bound Boxes; No. 13, Cooperage and Steel Barrels; No. 14, Wooden Boxes; No. 15, Nailed Wooden Crates; No. 16, Baling.

Quality of Water of Colorado River in 1925-26, by W. D. Collins and C. S. Howard. U. S. Geological Survey Water-Supply Paper 596-B.

Statistical Classification of Imports into the United States, With Rates of Duty and Regulations Governing the Preparation of Monthly and Quarterly Statements of Imports, Effective January 1, 1927. Schedule A, Bureau of Foreign and Domestic Commerce. 40 cents.

Naval Stores Statistics for 1926, Reported by Department of Agriculture. Mimeographed statement from Office of Information, U. S. Department of Agriculture, dated July 8, 1927.

Production statistics from 1925 Census of Manufactures—printed pamphlets on: The Rubber Industries—Rubber Tires and Inner Tubes, Rubber Boots and Shoes, Rubber Goods Not Elsewhere Classified; Glass and Mirrors; Ammunition, Explosives, Firearms, and Fireworks; The Clay-Products Industries—Clay Products (other than Pottery) and Nonclay Refractories, Pottery and Sand-Lime Brick; Tanning Materials, Natural Dyestuffs, Mordants and Assistants, and Sizes; Paper and Wood Pulp; The Leather Industries; Petroleum Refining; Butter, Cheese, and Condensed and Evaporated Milk; Slaughtering and Meat Packing and Related Industries. 5 cents each, except the last-named, which is 10 cents.

Mineral production statistics for 1926—preliminary mimeographed statements from Bureau of Mines on: Graphite and Copper.

THE PLANT NOTEBOOK
an exchange for OPERATING MEN

Unloading Tank Cars by Compressed Air

By L. G. Jones
Baltimore, Md.

Some time ago, I took some interesting data on unloading cars of 66 deg. Be. sulphuric acid by means of compressed air. I was particularly interested in the time required to unload the cars and the quantity of air consumed. Acid cars generally hold about 8,000 gallons when of standard size, although other sizes are also often used.

Fig. 1 is a curve showing the time required to empty cars using air at different pressures. When our air pressure was low, it took considerable time to unload the cars. The time required increases rapidly as the pressure of air is lowered. The reason is obvious, as the higher the pressure on the acid, the more rapid will be the flow of liquid through the pipe line to the plant storage tanks, thus decreasing the time required to empty the tank car.

Fig. 2 gives the rate of flow of air into the tank car, and as would be expected, the higher the air pressure, the greater the flow of air per minute into the tank car, provided the liquid is moving out of the tank at a correspondingly higher rate. In other words, the higher pressure air not only gives a greater differential and velocity into the tank but makes more room for additional air by the more rapid delivery of liquid from the tank.

Fig. 3, however, gives the total quantity of air consumed in emptying the car, as obtained from the previous two curves. More air is consumed by using high pressure air, in spite of the short time required to empty the car.

One of the interesting features of these curves is the variation in compressed air consumed at different air pressures. This, of course, is compensated for in the saving of time in unloading, which time may or may not be worth more than the extra air consumed.

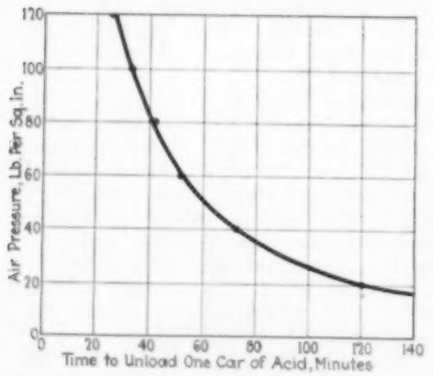


Fig. 1—Curve Showing Time Required to Unload Cars With Compressed Air

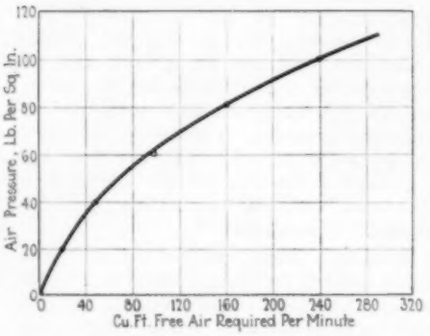


Fig. 2—Curve Showing Rate of Flow of Air Into Tank Cars

The following table illustrates this point:

Air Pressure, Lb. Gage	Air Consumed In Emptying Tank Car Cu.ft. free air	Time Taken in Emptying Tank Car Minutes
20	2400	120
60	4900	52
100	7600	33

Three times as much air of 100 lb. pressure is required to empty the car in almost one-fourth of the time taken under conditions of air at 20 lb. pressure.

Fig. III shows that the quantity of air required to empty the tank is almost exactly the volume of the tank car in cubic feet, which, corrected to atmospheric pressure from the given air pressure, gives the free air. For example, an 8,000 gallon tank is equivalent to 1,066 cu.ft. This calculates, in terms of free air, as follows:

Air Pressure Lb. Gage	Correction factor to Atmospheric Pressure	Free Air Equivalant Cu. Ft. Corrected Air
0	1.0	1066
20	2.67	2482
40	3.67	3900
100	7.33	7812

Welding of High-Chromium Alloys

In a recent paper before the American Electrochemical Society, Stanley M. Norwood, of the Union Carbide & Carbon Research Laboratories, Inc., discussed the welding of alloys containing more than 10 per cent chromium.

It has been found possible to weld these materials satisfactorily for certain uses, but success has not been attained where exceptionally high strength and ductility are desired, as in the welding of pressure vessels.

The welding of high-chromium alloys gives rise to infusible oxides which are difficult to float to the surface of the weld. Unless these oxides are removed, they constitute points of weakness. Recently, fluxes have been developed which slag off these oxides and protect the metal from excessive oxidation during welding.

In alloys consisting chiefly of chromium and iron, certain other difficulties become apparent after a weld is completed, notably a lack of ductility in the weld and in the metal adjacent. When not over 20 per cent chromium is used, this can be remedied to some extent by heat treatment, where it is possible to apply that process. With more than 20 per cent chromium, heat treatment is not effective.

Experiments have led to the conclusion that the remedy lies in adding about 8 per cent of nickel to high-chromium alloys. This refines the grain and improves the ductility and shock resistance, while at the same time preventing the development of brittleness after welding. It also improves slightly the welding qualities of the alloy.

Nickel has a tendency to lessen the corrosion resistant properties of the alloy to sulphur, sulphur dioxide and certain other media. This objection can be overcome by increasing the silicon content to about 2 per cent. It has also been found that if the percentage of manganese is made approximately equal to that of silicon, a flux-covered welding rod becomes unnecessary.

Such additions to high-chromium alloys, especially those containing over 20 per cent chromium, have been found to solve most of the difficulties encountered in welding such alloys, while affording at the same time a composition easy to weld and having ductility in the weld without heat treatment.

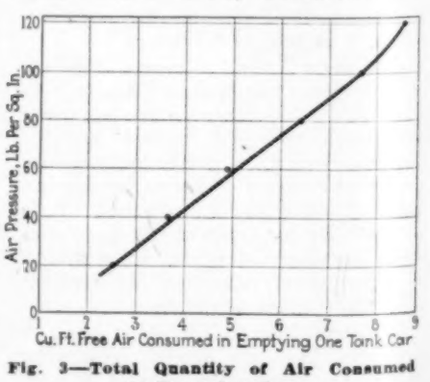


Fig. 3—Total Quantity of Air Consumed in Emptying Cars

Determining Area Required For Clarification

By Noel Cunningham
York, Pa.

The determination of the necessary sedimentation area for the removal of solids from liquid suspension is important in many processes. The following discussion covers briefly the manipulation and calculations involved, and the application in determining proper thickening and clarification equipment.

Flows should be charted over sufficient time to assure accurate knowledge of maximum, normal and minimum flows and careful samples should be taken of representative flows. The specific gravity of the dry solid is determined for use in determining the ratio of dry solid to liquid.

The first step is to weigh a 1,000 c.c. graduate containing 1,000 c.c. of pulp, and deduct the weight of the graduate to get the net weight of the pulp. Allow to settle and decant off as much clear liquid as possible. Determine the specific gravity of the clear liquor with a hydrometer. If liquor contains salts in solution, the pulp must be thoroughly washed. Then evaporate to dryness and determine the per cent moisture. The specific gravity of the dry solid can then be determined from the following:

$$M = \frac{100\,L\,(S-P)}{P\,(S-1)} \qquad (1)$$

where M = per cent moisture
L = specific gravity of liquor
S = specific gravity of dry solid
P = specific gravity of pulp

It is convenient to use for determining the specific gravity of the dry solid one of the 1,000 c.c. samples left after completing the manipulation described below, as this gives at the same time the ratio of solid to liquid in the feed, which must be known in order to calculate tank areas.

The next step is to fill three 1,000 c.c. graduates each with 1,000 c.c. of pulp at the flow density that is to be studied. Mix the contents of one of these thoroughly by inverting back and forth. Then, as the pulp settles, read its height at one minute intervals, or thirty second intervals if settling is rapid, until settling is complete. From this data the average rate of settling can be determined.

Readings should be repeated to establish a uniform rate. After this is done, decant 500 c.c. from each of the two other graduates, saving this decanted liquor. Then mix the pulp remaining in these two graduates, giving one graduate containing 1,000 c.c. of pulp of double feed density. Refill the empty graduate with feed pulp and set it aside. Then determine settling rate for pulp of double feed density.

By this time graduate No. 1 will have settled so that an amount of clear liquor can be decanted. Take off sufficient clear liquor from graduates 1 and 3 to leave 1,000 c.c., which, when poured together will have three times the feed density. Determine the rate of settling for this density. In this way rates of settling can be determined for multiples of the feed density as long as measurable rates of settling occur.

Where the original flow will not give a sufficiently clear demarkation between pulp level and supernatant liquor, resort must be had to induced coagulation. The effect of mechanical, chemical and colloidal coagulation should be tried in the order named.

Having determined settling rates at all possible multiples of flow density, the necessary area can be computed from the following:

$$A = \frac{2{,}000}{\dfrac{62.35 \times 24 \times R}{F-D}} \qquad (2)$$

where A = area in sq.ft. required to settle 1 ton of 2,000 lb. of dry solid, fed at a liquid to dry solid ratio of F, having a settling rate R at ratio F, D being the liquid to dry solid ratio at which underflow is to be withdrawn.

In applying this formula it will be found in practically every case that the area of the sedimentation basin is controlled by the densities in the slower, thick zones, not by the feed density.

The density at which underflow can be carried is determined as follows: The graduate containing the pulp from the final determination of rate of settling is allowed to stand and readings taken at intervals until no further settlement occurs, recording elapsed time and c.c. of settled pulp. The ratio of liquid to dry solid in the settled pulp is found by:

$$D = \left(R - \frac{A}{S}\right)\frac{L}{A} \qquad (3)$$

where D = ratio of liquid to solid after an elapsed time, t
R = c.c. of settled pulp
A = grams of dry solid
S = specific gravity of dry solid
L = specific gravity of clear liquid.

In applying results obtained by formula (3), it will be found that the value of D becomes practically stationary after a certain time which varies for different materials. Storage must be provided in the sedimentation basin to give the pulp the time indicated by the various readings to reach the value of D selected. This means increasing the depth of the settling basin to provide the pulp retention period indicated. There is an economic limit obtained by balancing cost of increased depth against advantage of thicker underflow. Most materials reach a point in a few hours beyond which very little further compacting occurs and it is customary to select the value D at this point.

It has always been evident that, if some method was evolved to reduce the tendency for the slow zones to build up in sedimentation, the same work could be done in smaller areas. This can be done by providing filtration through the bottom of the basin in order to draw down the solid thereby lowering the density column. This procedure also cuts down the retention period required to produce a desired underflow thickness, so that shallow settling basins can be used.

In determining areas required for determination to cases where filtration through the bottom is used a balance of capital expenditure against operating cost must be made. In general, halving the area is the maximum advisable and the corresponding capital saving will be roughly 40 per cent. Operation cost is increased by the cost of renewal of the destructable filter.

In determining areas required for sedimentation as effected by bottom sand filtration, the manipulation outlined is made and results tabulated. The action of small suspensions of the solid are then studied under suction in a dispensing burette with a 4 in. deep granular bottom using different vacuums. By plotting curves using time in minutes as ordinates and filtering rate as abscissas a new value of R in formula (2) may be determined. However, further study is needed before an exact rule can be formulated and it is well to try out the effect in a small working model.

Water Wheels for Driving Pumps

In certain plants the presence of fumes, salt, water or other substance which would damage an electric motor practically prohibits the use of electric motor drive. In such a case a water wheel drive can be used to advantage.

An example of this is found in the plant of the Wadsworth Salt Co., Wadsworth, Ohio. In that plant fourteen water wheel driven centrifugal pumps are used for handling brine solutions. The motive power for these small water wheels is supplied by water from a large centrifugal pump driven by a 400-hp. steam turbine. The turbine takes steam at about 135 lb. per sq.in. and exhausts at about 10 lb. per sq.in. The exhaust steam is used in the evaporators, by which means the overall economy of the operation is improved.

Handling "Broke" at the Wet End

In making paper on a wide fourdrinier machine there are times, when breaks occur, when a considerable amount of wet fiber is dropped from the squeeze rolls to the floor as "broke." This has to be quickly pushed aside to allow the workmen to start the paper again. Invariably as much of it lands behind the machine as in front and in mills where "behind" means against a wall, means are necessary to get it back into a broke basket in the aisle in front of the machine.

In one plant this has been accomplished by running a short continuous belt conveyor in a wooden trough directly across the machine over the final squeeze roll. This empties into a basket kept alongside at all times. Broke need not accumulate behind a machine thus equipped and at the same time its recovery involves no hazard to the worker.

EQUIPMENT NEWS *from* MAKER *and* USER

Glass-Lined Equipment

The Pfaudler Co., Rochester, N. Y., announces a new interchangeable series of highly acid-resistant process equipment. This equipment is recommended for use with concentrated or dilute hydrochloric, nitric, sulphuric, C. P. phosphoric, hydrobromic and hydriodic acids at room or boiling temperatures; with ammonium hydroxide at any concentration; and with all organic acids. It should not be used with products containing hydrofluoric acid, fluorides (such as commercial phosphoric acid), or with any of the alkalis.

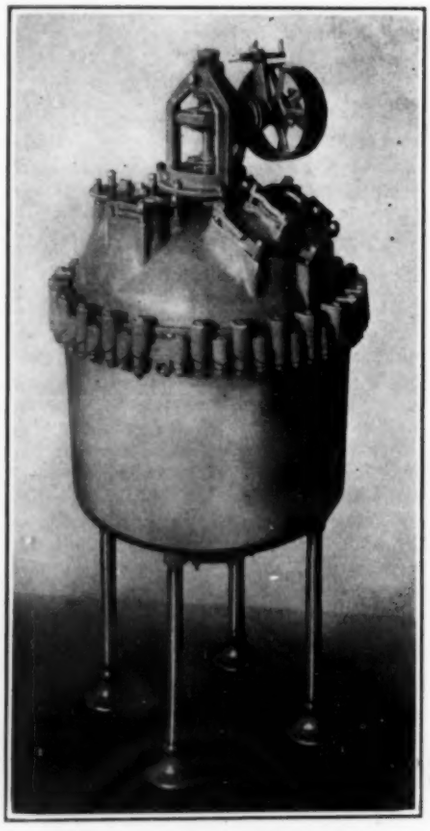
There are forty-four standard models in this new series of equipment, many of which are interchangeable. For instance, an open jacketed tank can be equipped with top and agitator at any time. There are ten single-shell open models, ten single-shell closed models, ten open jacketed and ten closed jacketed models and four special models. Capacities range from 37½ to 300 gal. This equipment is classified in three series: S, M and L.

The "S" series, including three sizes, 37½, 75, and 100 gal., has a standard inside diameter of 32 in. In any of the three sizes, the same top head and bottom head are used; the varying capacities being obtained by increasing the depth of the shell.

The same principle is used in the other two series. The "M" series has a standard diameter of 40 in., and includes capacities of 75, 100, 150, and 200 gal. The "L" series includes the 150, 200, and 300 gal. sizes, all of which have a standard diameter of 48 in.

The inner shells of all of the kettles, irrespective of series, are of a tapered construction. This tapered feature permits the welding of the jacket along one line only, eliminating the traditional cone which requires two lines of welding. Any of the standard jacketed units will be furnished with a partial jacket, in which case the unit will be excellently suited for use as a nitrator or general vacuum pan. Any of the closed models may be had with or without agitator.

The four special models are in the form of a 75 gal. open and closed construction, and a 300 gal. open and closed construction. The 75-gal. unit is called an all purpose unit, and consists of a cast iron jacket with a steel enameled liner. This liner can be removed and the operator can carry an extra liner at his plant for emergency purposes. The 300 gal. unit has similar advantages, except that the entire construction is cast iron enameled.



All-Purpose, 75-Gal. Glass-Lined Reaction Kettle

Flow Controller

A line of automatic flow rate controllers has been developed by Cochrane Corporation, Philadelphia, Pa. This controller comes for pipes from 1¼ to 14 in. diameter. The difference in pressure set up by flow past a disk in the entrance chamber exerts force upon a valve member in opposition to a spring. When the rate of flow is greater than that for which the spring tension has been adjusted, the valve will be shifted toward the closed position, and vice versa, coming to rest in a position such that the area through the discharge ports is just sufficient, with the pressure existing in the supply line, to discharge the desired quantity of fluid.

In order to supply a visible indication that fluid is being passed at the desired rate a small valve is opened as soon as the disk and valve are moved in opposition to the spring tension. This valve is connected to a petcock which can be opened by the operator. If nothing discharges from the pet cock, flow is less than the desired rate and this serves as a signal to seek the cause of the deficiency.

Speed Reducers

The Falk Corporation, Milwaukee, Wis., has brought out a new line of speed reducers, of the continuous tooth, all steel herringbone gear type. A new design of housing eliminates any internal ribs, projections or complicated cores. Lubrication has thus been simplified. Bearings are of airplane type, steel-backed and babbitt lined.

These reducers are made in three types; single reduction for ratios up to 9 to 1, double reduction for ratios up to 70 to 1, and triple reduction for ratios up to 300 to 1.

Electrical Equipment

The General Electric Co., Schenectady, N. Y., announces a new float switch bearing the designation CR-2931-P for use in control circuits only. This switch, in general, will be used to control the line contactor of alternating or direct current automatic starters. It has a capacity for handling one 600-ampere, two 300-ampere or four 150-ampere a-c, or d-c, contactors at from 110 to 550 volts.

A very simple design is employed. No castings are used. A double contact eliminates shunts, and oxidation trouble has been eliminated by the use of silver contacts. The movable contacts are held by a molded bakelite arm which obtains its snap action in opening and closing the switch through a special mechanism.

The switch may be attached directly to a support extending across the tank or by means of a side bracket supplied with it. This bracket is reversible, and provides for various methods of fastening. The case, which is splash-proof, has provision for a half-inch conduit at the top.

To meet the demand for a smaller and cheaper magnetic switch with temperature overload relays, the General Electric Co. has designed a device bearing the designation CR-7006-D-20. This switch requires a very small mounting space, has a particularly neat appearance both inside and outside and has many desirable electrical features.

The enclosing case is of the drawn-shell type, both box and cover being of the same dimensions. The cover hooks over two pins at the top and is fastened by means of a screw at the bottom. During installation the base is removed from the case, thus making it easier to fasten the case to its mounting, to install the conduit and pull in the leads.

Very large barriers are used, permitting the switch to interrupt extremely high currents. The electrical interlock

is so designed that, by removing a wire from the back of the base, it is possible to use the switch on insulated circuits. Overload protection is provided by means of a Trumbull relay held in position on the panel by fuse clips. These relays can easily be changed to suit the size of motors involved. The relays are self-resetting and, therefore, the switch can be used with three-wire circuit (push-button) control only.

A new portable meter to be used as a standard in meter testing has been introduced by the General Electric Co. The new meter, designated as Type IB-7, is made for 110-220 volts, 25 or 60 cycles, and 1/5/20 amperes. The effects of variation in voltage, frequency and power-factor are minimized to negligible values, and there is almost entire freedom from temperature errors.

The case is of cast aluminum alloy, finished in black lacquer and is provided with a black leather carrying strap. The white enamel dial is easily read against the black bakelite top. A light, rigid, aluminum alloy frame supports the entire meter element, and is firmly attached to the molded bakelite top. The base of the frame is flat, so that when the metering unit is removed from the case it stands upright on the bench, facilitating inspection or adjustments.

On both full and light loads, adjustments are made with micrometer screws. The meter is also provided with an adjustment for regulating its operation on inductive loads. The one-ampere winding is protected from accidental overload or short circuit by a fuse, and a spare fuse is carried in the cover. A gasket between the top panel and the case makes the meter dust- and moisture-proof; the dial chamber is similarly protected by a gasket between the flange and top panel. A zero set-back device is controlled by a knurled bakelite knob; the terminals are also of molded bakelite with positive grips.

Belt Conveyor Idler

Anti-friction belt conveyor idler and return rolls have recently been placed on the market by Link-Belt Co., Chicago, Ill. These rolls are equipped with Timken tapered roller bearings, totally encased within the roll hub.

A feature is the labyrinth grease seal, mounted in a grease cap which also serves as an outboard reservoir and lubricates the bearing on the outside as well as on the inside, especially when the roll is on an incline. This, in turn, is protected by a deflector plate which deflects foreign material away from the bearings and grease seal and prevents the washing of the grease away from the labyrinth.

The rolls are mounted on a self-cleaning "T" base. They are interchangeable being capable of serving in any of the three positions. Another advantage claimed is the close working tolerances to which all parts are built, said to be closer than have been previously attempted in belt conveyor equipment. Roll shells are machined to uniform wall thickness.

The material of the roll shell can be varied to suit the working conditions. A special metal is used for coke plant conveyors, to resist the sulphur fumes and coke dust abrasion. Rolls are granitized for the handling of salt, alkali and materials having similar action.

Idler rolls are made in various standard lengths and they are furnished in combinations to suit standard belt widths. The end stands are riveted to the "T" iron base and are spread at the foot to present a rigid support for the idler.

Backlash Eliminator

In developing its torque amplifier, the Bethlehem Steel Co., Bethlehem, Pa., also developed the "Lashlock" (Nieman patents). This device has been applied to a wide range of machinery, from large mechanism involving great forces to small and delicate instruments. It operates to eliminate backlash in gearwheels, feed-screws, endthrusts, bearings—practically wherever play occurs between moving members. It also compensates for wear, and automatically relieves strain caused either by tight setting or expansion due to heat. The action is positive, without slip or yielding under load, and it in no way lessens the power which can be transmitted or weakens the members to which it is applied. Entirely automatic, it never requires hand adjustment, and needs only the minimum of lubrication.

The basic principle of the lashlock will be seen from Fig. 1. A wedge-shaped member, *1*, slides on a stem, *2*, which is urged downward by the light spring *3*. Two rollers *4* and *5*, are disposed so that they press against the wedge, as shown. It is obvious that if both rollers press simultaneously against the wedge it will be forced upwards, readily overcoming the pressure of the light spring. What may not be so obvious at first glance is that, with the slope of the wedge approximately as shown (5 to 10 deg. on each side of the axis), if only one roller is pressed against the wedge the friction between the wedge and stem will be greater than the upward force imparted to the wedge, and the wedge will bind upon the stem. All the force applied to the single roller will thus be imparted to the member which supports the stem, forcing it in the direction in which the roller presses. This binding or locking effect will occur no matter how great the force applied to the single roller, as the proportion between the friction on the stem and the upward force imparted to the wedge remains the same. When both rollers are pressed simultaneously, however, the pressures are balanced and no friction results between wedge and stem; thus all the force applied to the two rollers is brought to bear on moving the wedge upward.

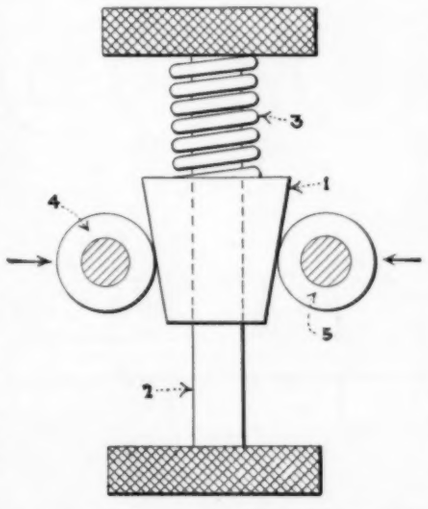


Fig. 1—Diagram Showing Basic Principle of Backlash Eliminator

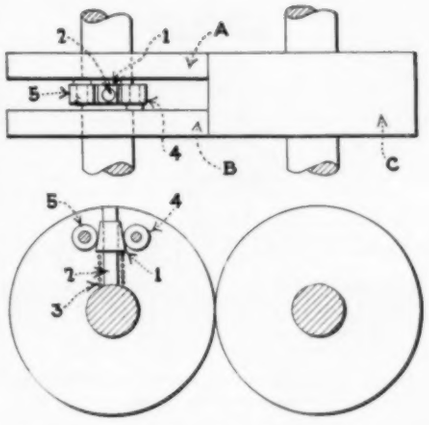


Fig. 2—Application of Backlash Eliminator to a Split-Gear Element

From this examination it is seen that the action depends upon two things: a frictional locking when only one roller is pressed; and a complete release when both rollers are pressed simultaneously.

Application of the above working principle to mechanical movements can be accomplished in a variety of ways, provided the essential elements are always included. Take, for example, a pair of gear wheels, a mechanical combination notorious for backlash—in which, as a matter of fact, a certain amount of backlash has always had to be allowed for in the design and setting. Several methods have been used to mitigate the backlash in gears, perhaps the most widely known being the "split" gear. The use of split gears is limited to mechanisms through which only small forces are transmitted. Incorporating the lashlock in a split gear, however, transforms it from a weak element with a narrow range of usefulness into a strong, positive-acting element capable of being widely applied to both light and heavy-duty machinery.

In Fig. *2* is illustrated, diagrammatically, the principle applied to a split-gear element. *A* and *B* are the split members, meshing with the solid gear *C*. Stem *2* is attached rigidly to the shaft which carries the split pair, and on the stem is mounted the wedge member *1*. Rollers *4* and *5* are attached respectively to gear *A* and *B*. A light

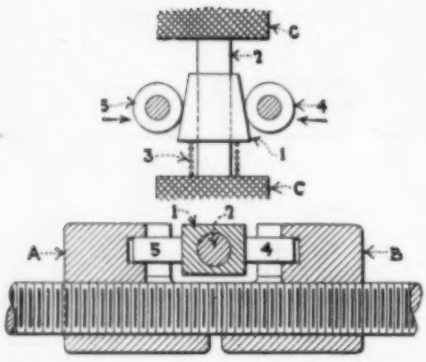


Fig. 3—Application of Backlash Eliminator to a Screw Feed

spring, *3*, is mounted so as to urge the wedge away from the shaft, thus urging apart rollers *4* and *5*, and through them imparting rotational urge in opposite directions to the gears *A* and *B*. The wedge will be pushed outward until the teeth on gears *A* and *B* lightly pinch the teeth on gear *C*; this may be termed the "normal" position of the wedge. There are only two circumstances which can cause the wedge to change from this normal position; either both of the rollers *4* and *5* press on it simultaneously, or both simultaneously relieve their pressure. Pressure of only one roller will cause binding friction of wedge on stem; therefore, when gear *C* begins to drive it will cause one of the split pair to exert pressure on its respective roller and so on one side of the wedge; thus the driving force of *C* will be transmitted to the stem and so to the shaft which carries the split pair. (Gear *C* may, of course, be the driven gear). If *C* reverses the direction of its drive the other roller will press against the wedge and the shaft driven oppositely. There will be no instant when neither roller is exerting pressure on the wedge, and no instant when both rollers are pressing simultaneously.

All this is true provided the teeth on all the gears are accurately cut. If they are of different size, through inaccurate cutting or wear, a thick tooth will urge the rollers together and move the wedge outward, while a thin tooth will permit the spring to push the wedge inward and cause the split pair to pinch a little more closely. It must be remembered that the pinching is always a light force, because the spring which urges the wedge outward need be only of light force—practically negligible compared with the other forces involved—for the lock action is through positive frictional locking and bears no relation to the strength of the spring employed on the wedge. In the non-lashlock type of split gear the pinching is necessarily always comparatively severe because the spring must be heavy enough to take the full load of the drive in one direction. It will easily be understood, then, how by this accommodating inward and outward movement of the wedge all irregularities of the teeth are compensated for, that the action is immediate and automatic, and that the teeth never are put under strain.

In case, through lack of lubrication, the wedge should tend to stick on its stem, the outward push of the rollers would overcome such friction without subjecting the gears to any considerable strain; the only result of sticking is failure of the spring to push the wedge inward, which means that the backlash would not be adequately eliminated.

The diagram does not give an actual idea of the construction of a set of these gears. The lashlock requires but little space, and need not be set inside the gears at all. It has been positioned, for instance, on a handwheel on the end of a shaft a foot or more from any of the gears. One lashlock may eliminate backlash from a train of gears, or from a combination of gears, worms, racks, etc., provided that the gearing is doubled, one set for driving in each direction.

Application of the lashlock to a screw-feed is illustrated in Fig 3. Here the same scheme is followed as with the gearing. Two nuts, *A* and *B*, run on a screw shaft. The wedge, *1*, is mounted on a stem, *2*, which is supported by the housing of the driven member, while rollers *4* and *5* are attached to nuts *B* and *A* respectively. The wedge as it is pressed forward by the spring, *3*, urges the nuts apart. When the screw-shaft is turned in one direction one of the nuts forces its roller against one side of the wedge, a frictional binding is created, and through the stem the drive is transmitted to the driven member. Reversal of the screw-shaft produces a drive through the other nut, in the opposite direction.

For thrust bearings—to eliminate endplay in a shaft—the lashlock installation is similar to that in a feed-screw, with the threads and nuts replaced by collars. Two collars are keyed to the shaft a slight distance apart; two other collars are mounted inside the first two, kept from revolving with the shaft but permitted a small endwise movement. These two inside collars each carry a roller so mounted as to press against a side of the wedge, the stem of which is attached to the fixed support which bears the thrust.

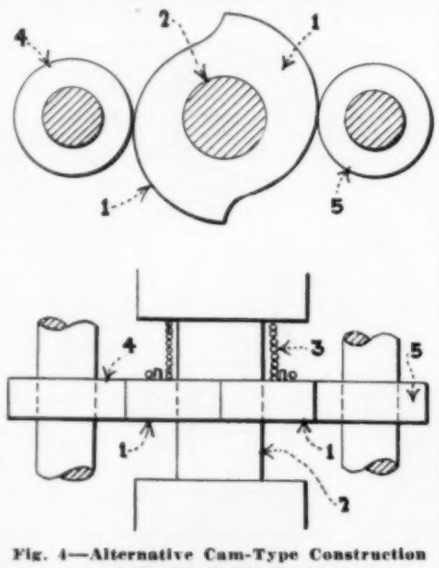


Fig. 4—Alternative Cam-Type Construction of Backlash Eliminator

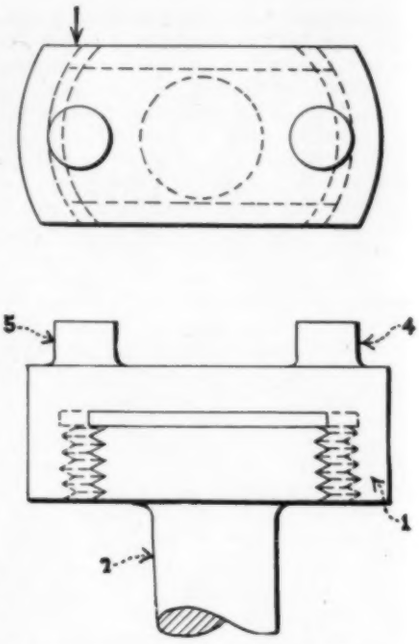


Fig. 5—Alternative Threaded-Type Construction of Backlash Eliminator

The spring will then urge the inside collars outward against the collars fixed on the shaft; the shaft will not be able, of course, to move endwise in either direction because to do so would mean moving the wedge by pressure on only one roller. Bearing metal is set between the collars and lubrication effected as usual. As the bearings wear, the wedge works inward, taking up this wear and holding the shaft always in the same position, endwise, as at the start.

Great flexibility is possible in designing the lashlock to meet situations, for the principle is capable of an astonishing variety of forms, some of which appear to depart far from the wedge and roller already illustrated, but all in fact adhering to the essentials of positive locking and automatic release of friction. One such alternative construction is the double cam shown in Fig. 4 Here a double cam replaces the wedge, with faces *1, 1;* the stem, *2*, is a pivot on which the cam revolves. Pressure of either one of the rollers *4* and *5* will cause a frictional locking between cam and pivot, because the cam faces are cut on an involute so that the pressure of the rollers is always a little to one side of the center. Pressure of both rollers simultaneously relieves the friction between cam and pivot and rotates the cam. The spring *3*, urges the cam in a rotary direction opposite to that caused by pressure of the rollers. This form of lashlock is interchangeable with the straightsided wedge, but fits better into certain constructions.

Another form of lashlock is that shown in Fig. 5. Here the place of the wedge member is taken by a member, *1*, of the shape shown. This is provided with two lugs, *4* and *5*, and with two downwardly projecting arms which form a partial cap embracing the member *2*, corresponding to the stem of Fig. 1. Members *1* and *2* are threaded into

each other. There are no rollers necessary. Simultaneous pressure on opposite sides of lugs *4* and *5*, as indicated by the arrows, rotates member *1* on member *2;* but pressure on only one lug produces a cocking effect, causes a frictional lock and prevents rotation. All the pressure on the one lug therefore acts to move the stem in the direction in which the lug delivers the pressure. This cocking and binding effect is the same thing that occurs when one attempts to open a bureau drawer by pulling on one handle; pressure on both lugs corresponds to pulling both handles together. This form of lashlock is used in the torque amplifier, or in any type of mechanism operating through friction bands, where it is desirable to eliminate backlash when reversal occurs between one drum and its oppositely rotating mate. It has not the high degree of accuracy of other forms.

As to the accuracy of the lashlock, while backlash elimination between moving members, by positive means, cannot be theoretically absolute, this theoretical play is insignificant with the lashlock. Tests have been made to determine this point. For example, a train consisting of worms and gears (all stock parts) was arranged to give a reduction of 200 to 1 and the angular movement of the primary drive gear and that of the final driven gear measured during a reversal of direction. The backlash of the driven gear was found to be less than 1/10 part of a minute of arc, which is entirely negligible. Gearing in this test was fairly heavy, designed to transmit 30 lb.-ft. of torque.

The lashlock is applicable to two general classes of machinery: those in which great accuracy is the chief factor, such as certain machine tools, precision instruments and control apparatus; and machines where the elimination of backlash will result in the production of better work and in prolonging the life of the machine by reducing the wear arising from looseness and chatter.

Lead-Lined Equipment

The Chemical Equipment Mfg. Co., Paterson, N. J. is now constructing and marketing a line of lead-lined equipment which is called "Homogeneous Lead-Lined Chemical Apparatus."

The process by which it is built is an outgrowth of European practice. Hence the trade term "homogeneous," which is of similar origin. The section of lead and steel is, of course, not homogeneous. The word is used to convey the idea that the lead is inseparably bonded to the steel, forming a combined section of unusual strength.

While all types of lead-lined equipment are made by this company, the process is said to be particularly well adapted to the construction of vacuum and pressure units of large size. Shipping containers or process equipment subjected to strain and vibration are also said to hold up unusually well under severe conditions when made by this process.

The fact that steel coated with lead in this manner may be twisted to destruction without separating the lead, allows great flexibility and speed in construction. Flat sheets are coated with lead and then formed and shaped into cylindrical vessels or containers. By this method flaws and pinholes are avoided over a large proportion of the lead-lined area. The steel sections are welded by the "Quasi-Arc" process and the welds then coated by the ordinary method of lead burning.

In addition to steel such metals as cast iron and bronze are also coated with lead by this process.

Brake

The Electric Controller & Manufacturing Co., Cleveland, Ohio, has brought out a new design of brake, type WB. This is a brake of the shoe type for which is claimed a longer life of brake-shoe linings. It is designed to permit quick removel of the motor armature with the brake wheel in place without the necessity of taking the brake apart or disturbing its adjustment. It is also said to be an exceptionally fast operating brake.

In this design no levers or rods pass over the top of the brake wheel. The brake shoe arms are caused to operate in an opposite direction by means of a lever movement having the connecting link within the base below the wheel.

Steel castings are used in the construction of this device. The linings are of asbestors interwoven with wire and molded to shape under pressure. Linings are ½ in. thick on the smallest size and ¾ in. thick on the largest size, thus permitting a large amount of wear before replacement is necessary.

Factory Truck

The Howe Chain Co., Muskegon, Mich., is now manufacturing a small 3-wheel factory truck known as the "Jak-Tung."

This truck consists of a platform equipped with two malleable iron wheels at the rear and a malleable iron draw bar in the front. The jack tongue whence the truck takes its name, with a wheel, fits into the draw bar length and by a downward thrust of the handle, the load is raised and may be hauled.

This truck is built in 17 different sizes and 3 models, with either steel or hardwood platforms or trays in various combinations. It is recommended as a material conveyor in manufacturing plants for the handling of loose, bulk or packaged material and for the handling of heavy pieces of equipment up to 3 tons in weight. Advantages claimed for this truck are that it permits the keeping of material on wheels from one operation to the next, thus avoiding congestion, soilage and double handling. It is claimed that a train of 8 or 10 of these trucks together with a tractor can be used efficiently in narrow pathways, around sharp turns and around machinery.

Manufacturers' Latest Publications

Crandall Packing Company, Palmyra, N. Y.—Catalog 10—General catalog of all types of packing and gaskets made by this company.

S. F. Bowser & Company, Inc., Fort Wayne, Ind. — Folder describing various types of oil storage and handling equipment.

Chain Belt Company, Milwaukee, Wis.—Catalog No. 220—New general catalog of "Rex" chains and transmission equipment, with new list prices as of July 1, 1927.

International Oxygen Company, Newark, N. J.—Catalog No. 27—A catalog of welding and cutting equipment.

Worthington Pump & Machinery Corporation, 115 Broadway, New York, N. Y. —Bulletin No. W613—Bulletin describing a new line of high efficiency, ball bearing, centrifugal pumps for general service.

De Laval Steam Turbine Company, Trenton, N. J.—New folder describing water pumping at the Chicago city water works.

Semet-Solvay Engineering Corporation, 40 Rector St., New York, N. Y.—Pamphlet 319—New leaflet on naphthalene troubles.

Expanded Metal Safety Guard Company, Long Island City, N. Y.—Circular No. 1—A folder describing various types of machinery guards.

Bristol Company, Waterbury, Conn.—Catalog No. 1502, Ammeter Section—New catalog of recording ammeters.

Hardinge Company, York, Pa. — New folder on Hardinge mills and super-thickeners.

International Nickel Company, 67 Wall St., New York, N. Y.—Second edition, July, 1927, of the "Buyers' Guide" for nickel alloy steel products.

Roller-Smith Company, 233 Broadway, New York, N. Y.—Supplement No. 1 to Bulletin 300—Folder describing portable, direct reading, type COM ohmmeter and type HTD circuit tester.

Horace Hills, Inc., 315 Montgomery St., San Francisco, Calif.—A folder describing a new design of mechanical pyrometer for temperatures up to 1200 deg. F.

Link-Belt Company, 910 S. Michigan Ave., Chicago, Ill.—Data Book 615—Complete catalog of Timken bearing equipped belt conveyors.

Warren Webster & Company, Camden, N. J.—Bulletin 1,200 — Announcement of thermostatic traps for use with process steam at pressures up to 100 lb. per sq.in.

Hills-McCanna Company, 2033 Elston Ave., Chicago, Ill.—A new folder on force-feed lubricating devices.

La Bour Company, Chicago Heights, Ill. —Bulletin No. 29—New bulletin describing self-priming, moderate speed, large clearance centrifugal pumps.

Lamson & Sessions Company, Cleveland, Ohio—Bulletin on high strength, heat treated bolts.

Niagara Blower Company, Buffalo, N. Y. —Stock list of sheets, pipe and fittings in lead, aluminum, copper and brass.

American Rolling Mill Company, Middletown, Ohio—A booklet entitled "Armco Ingot Iron—Its History and Service."

State Manufacturing Company, Chicago, Ill.—Bulletin describing the Haring cell for the measurement of resistivity, polarization and throwing power.

Thermo Electric Instrument Company, Irvington, N. J.—Folder describing Freas water baths.

Chicago Bridge & Iron Works, Chicago, Ill.—Bulletin on "Horton" tanks for sprinkler service and general fire protection.

General Electric Company, Schenectady, N. Y.—New publications as follows: GEA-37A, direct heat electric furnaces; GEA-80A, automatic reduced voltage starters for synchronous motors; GEA-104, cartridge heating units; GEA-164A, electrically heated metal melting pots; GEA-578A, type D mechanical drive turbines; GEA-597A, push- and pull-button control switches; GEA-598, steam turbines from 2,000 to 6,000 kw. capacity; GEA-703, station oil circuit breakers, 7,500 to 35,000 volts, 500 to 4,000 amperes; GEA-710, automatic generator voltage regulators; GEA-739, water-wheel-driven generators; GEA-750, induction frequency changers; GEA-754; semi-automatic reduced voltage starters for synchronous motors; GEA-758, automatic station control equipment; GEA-759, outdoor station equipment; GEA-765, CR7006-D20 magnetic switch; GEA-771, automatic switching equipment; GEA773, duplex controllers for a.c. squirrel-cage motors driving pumps.

PATENTS ISSUED
July 12 to Aug. 2, 1927

PAPER, PULP AND SUGAR

Method of Making Sulphite Cooking Liquor. George A. Richter, Berlin, N. H., assignor to Brown Company, Berlin, N. H. —1,637,353.

Process of Producing White Pulp of High Strength. George A. Richter, Berlin, N. H., assignor to Brown Company, Berlin, N. H. —1,635,637.

RUBBER AND SYNTHETIC PLASTICS

Art of Vulcanizing Rubber. Jan Teppema, Akron, Ohio, assignor to The Goodyear Tire & Rubber Company, Akron, Ohio. —1,637,790.

Art of Vulcanizing Rubber. Jan Teppema, Akron, Ohio, assignor to The Goodyear Tire & Rubber Company, Akron, Ohio. —1,637,791.

Method of Accelerating the Vulcanization of Rubber and Product Thereof. Lorin B. Sebrell, Akron, Ohio, assignor to The Goodyear Tire & Rubber Company, Akron, Ohio. —1,635,193.

Method of Making Dipped Rubber Articles. John Hadfield, Akron, Ohio, assignor to John R. Gammeter, Akron, Ohio. —1,635,576.

Chlorinated-Rubber Varnish. Norris Boehmer, Montclair, N. J., assignor to Chadeloid Chemical Company, New York, N. Y.—1,635,812.

PETROLEUM REFINING

Method of and Apparatus for Treating Petroleum. Joseph W. Lewis, Jr., Philadelphia, Pa., assignor to The Atlantic Refining Company, Philadelphia, Pa.—1,636,520.

Process of and Apparatus for Breaking Up the Components of Petroleum and the Like Into More Volatile Products. Willet C. Wells and Frank E. Wells, Columbus, Ohio.—1,635,519.

Purification of Oils. Friedrich W. Weber, Hackensack, N. J.—1,636,946.

Art of Refining Oils. Charles Leaver, Imperoyal, Nova Scotia, Canada, assignor to Imperial Oil, Limited.—1,635,718.

Art of Decolorizing Clarifying, and Purifying Petroleum Oils. Harold Lester Kauffman and Irwin Arthur Clark, Denver, Colo., assignors, by mesne assignments, to said Kauffman.—1,636,938.

Mineral-Oil Derivative and Process of Making Same. Gellert Alleman, Swarthmore, Pa., assignor to Sun Oil Company, Philadelphia, Pa.—1,637,510.

Method of Concentrating Sludge Acids. Arthur A. Vineyard, Wood River, Ill.— 1,636,724.

Apparatus for the Solidification of Liquid Hydrocarbons. Hippolyte Neveu, Paris, France, assignor to Ysabel de Paniagua, Paris, France.—1,636,644.

Wax Emulsion. Lewis Davis, Worcester, and Elmer W. Bennett, Westboro, Mass., assignors to Davis & Bennett, Inc., Worcester, Mass.—1,637,475.

Distilling with Aluminum Chloride. Almer McDuffie McAffee, Port Arthur, Tex., assignor to Gulf Refining Company, Pittsburgh, Pa.—1,636,144.

Process of Making Grease. James McKee, Chester, Pa., assignor to Sun Oil Company, Philadelphia, Pa.—1,637,703.

Bubble-Absorption Tower. Harry E. Shay, Los Angeles, Calif., assignor of one-third to W. A. Masters and one-third to J. L. Murray, Los Angeles, Calif.—1,635,440.

COAL PROCESSING

Method of Distilling Coal. Robert G. Griswold, Westfield, N. J., assignor to Doherty Research Company, New York, N. Y.—1,635,667.

Retort Oven for Low-Temperature Carbonization. Pierre Charles Zuyderhoudt, Brussels, Belgium; Madame Fanny Zuyderhoudt executor of said Pierre Charles Zuyderhoudt, deceased.—1,636,975.

Distillation of Tar. John Stanley Morgan and Douglas Rider, London, England, assignors to Thermal Industrial and Chemical (T. I. C.) Research Company, Limited, London, England.—1,635,896.

Method of Treating Artificial Fuels. Herbert E. Wetherbee, Cleveland, Ohio, and William L. Jacobus, Wilkes-Barre, Pa., assignors of one-third to Richard F. Grant, one-third to Howard M. Hanna, and one-third to Herbert E. Wetherbee, Cleveland, Ohio.—1,635,520.

ORGANIC PROCESSES

Chloro Derivatives of N-Dihydro-1,2,1',2'-Anthraquinone-Azine and Process of Making Same. Oakley M. Bishop, Wilmington, Del., assignor to E. I. du Pont de Nemours & Company, Wilmington, Del.—1,637,851.

Process for the Manufacture of Anthraquinone Derivatives. William Henry Perkin, Oxford, and Alexander Walker Fyfe and Mordecai Mendoza, Manchester, England, assignors to British Dyestuffs Corporation Limited, Manchester, England.— 1,636,485.

Azo Dye and Process of Producing Same. Hermann Wagner, Soden-on-the-Taunus, Germany, assignor to Grasselli Dyestuff Corporation, New York, N. Y.—1,635,594.

Process of Producing Anthraquinone. Augustus E. Craver, Cliffside, N. J., assignor to The Barrett Company.—1,636,856.

Production of Aromatic Aldehydes. Augustus E. Craver, Cliffside, N. J., assignor to The Barrett Company.—1,636,855.

Process of Producing Acetaldehyde. Augustus E. Craver, Cliffside, N. J., assignor to The Barrett Company.—1,636,952.

Reaction Product of Sulphur Dichloride and Primary Arylamines. Richard Herz, Franfort-on-the-Main, Germany, assignor to Grasselli Dyestuff Corporation, New York, N. Y.—1,637,023.

Production of Cobaltous Acetate. Hermann Schatz, Schwanheim-on-the-Main, Germany, assignor to the Firm I. G. Farbenindustrie Aktiengesselschaft, Frankfort-on-the-Main, Germany.—1,637,281.

Resinous Condensation Product from Dihydroxydiphenylethane and reactive Methylene Bodies and Process of Making Same. Leo H. Baekeland, Yonkers, N. Y., assignor to Bakelite Corporation, New York, N. Y.—1,637,512.

Manufacture of Hexamethylenetetramine. Carnie B. Carter, Pittsburgh, Pa., assignor to S. Karpen & Bros., Chicago, Ill.— 1,635,707.

Manufacture of Alkali Metal Xanthates. Wilhelm Hirschkind, Antioch, Calif., assingor to Great Western Electro Chemical Company, San Francisco, Calif.—1,636,229.

Barbituric-Acid Derivative. Ernest H. Volwiler, Highland Park, Ill., assignor to Abbott Laboratories, North Chicago, Ill.— 1,636,201.

Benzoxazolon Arsine Oxides. Ludwig Benda, Mainkur, near Frankfort-on-the-Main, and Otto Sievers, Fechenheim, near Frankfort-on-the-Main, Germany, assignors to I. G. Farbenindustrie Aktiengesellschaft. —1,635,167.

Benzoxazolon Arsonic Acids. Ludwig Benda, Mainkur, near Frankfort-on-the-and Otto Sievers, Fechenheim, near Frankfort-on-the-Main, Germany, assignors to I. G. Farbenindustrie Aktiengesellschaft.— 1,635,168.

Catalytic Oxidation of Aromatic Hydrocarbons. Augustus E. Craver, Cliffside, N. J., assignor to The Barrett Company.— 1,636,854.

Production of Maleic Acid. Augustus E. Craver, Cleveland, Ohio, assignor to The Barrett Company.—1,636,857.

Process of Manufacturing Acetic Anhydride. Rudolf Meingast and Martin Mudgan, Munich, Germany, assignors to Consortium für Elektrochemische Industrie, Munich, Germany.—1,636,701.

Process of Producing Indophenol Compounds. Walter A. Manss, Wilmington, Del., assignor to E. I. du Pont de Nemours & Company, Wilmington, Del.—1,637,868.

Process of Making Sulphur Phenol Resin. Carleton Ellis, Montclair, N. J.—1,636,596.

Water-Soluble Condensation Products and Process of Making Same. Karl Daimler, Franz Marschall, and Gerhard Balle, Hochst-on-the-Main, Germany, assignors by mesne assignments, to Grasselli Dyestuff Corporation, New York, N. Y.— 1,635,883.

Production of Organic Compounds. Karl Friedrich Schmidt, Heidelberg, and Philipp Zutavern, Ludwigshafen-on-the-Rhine, Germany, assignors to Knoll & Co., Ludwigshafen-on-the-Rhine, Germany.—1,637,661.

Stable and Sterilizable Solutions Containing Organic Phosphorus and Complex Aurosignors to Ellis-Foster Company.—1,637,990.

Compounds. Louis Benda, Mainkur, near Frankfort-on-the-Main, Germany, assignor to I. G. Farbenindustrie Aktiengesellschaft. —1,635,169.

Manufacture of Furane. William Courtney Wilson, Chicago, Ill., assignor to The Quaker Oats Company, Chicago, Ill.— 1,636,030.

Process for the Production of Ethyl Chloride. Hermann Suida, Modling, near Vienna, Austria.—1,637,972.

Dye Solution. Karl Lüttin, Basel, Switzerland, assignor to The Society T. R. Geigy A. G., Basel, Switzerland.—1,635,628.

INORGANIC PROCESSES

Method of Producing Alkali-Metal Sulphydrates. Ernest Eugene Naef, Paris, assignor to Tubize Artificial Silk Company of America.—1,636,106.

Process of Oxidizing Ferrous Sulphate in Solution. Alexander Elliott, Los Angeles, Calif.—1,636,296.

Manufacture of White Lead. George Freeman Lloyd, Brighton, and Frederick Harper Campbell, Melbourne, Victoria, Australia, assignors to Commonwealth White Lead and Paints Proprietary Limited, Melbourne, Australia.—1,635,759.

Production of Caustic Alkali, Etc. Linn Bradley, Montclair, N. J., and Edward P. McKeefe, New York, N. Y.—1,637,514.

Lime-Sludge Product and Process of Making the Same. Clarence J. Herrly, Pittsburgh, Pa., assignor to The Prest-O-Lite Company, Inc.—1,635,212.

Manufacture of Alkaline Potassium Compounds. Wilhelm Siegel, Berlin-Charlottenburg, Germany.—1,636,710.

Method of and Product for Making Plaster. George B. Wood, Rockland, Me., assignor to Rockland & Rockport Lime Corporation, Rockland, Me.—1,635,391.

Process for Dissolving a Mixture of Hafnium and Zirconium Phosphates and for Separating Hafnium and Zirconium. Anton Eduard van Arkel and Jan Hendrik de Boer, Eindhoven, Netherlands, assignors to N. V. Philips' Gloeilampenfabrieken, Eindhoven, Netherlands.—1,636,493.

Manufacture of Nitric Acid. Edwin L. Nellis, Allentown, Pa., assignor to Trojan Powder Company, New York, N. Y.— 1,635,949.

Production of Catalyst Carrier. Charles Raymond Downs, Yonkers, N. Y.—1,636,685.

Process of Treating Aluminous Ores. Richard Moldenke, Watchung, N. J.— 1,637,451.

Process for Preparing Water-Softening Materials. George W. Prather, Des Moines, Iowa.—1,636,942.

CHEMICAL ENGINEERING EQUIPMENT

Ball or Tube Mill. Wilhelm Köppen, Beckum, and Christian Pfeiffer, Neubeckum, Germany.—1,636,138.

Grinding, Crushing, and Mixing Machine or Mill. Joseph Emile Gernelle-Danloy, Rouen, France.—1,636,360.

Ball Mill. William M. Barker, Canton, Ohio.—1,636,585.

Apparatus for Cleaning, Collecting, or Separating Gases. Gerardus Jacobus Ulrici, Dusseldorf, Grafenberg, Germany.— 1,637,597.

Apparatus for Extracting Gas. Emanuel W. Hartman, Miami, Fla.—1,635,620.

Method of and Means for Removing Foreign Gas from Condensers. George Hilger, Chicago, Ill.—1,636,512.

Centrifugal Impact Pulverizer. Francis E. Agnew, Los Angeles, Calif., assignor to Minerva A. Brotherton, Santa Barbara, Calif.—1,636,033.

Pulverizing Machine. Paul Arthur Hirsch, New York, N. Y., assignor to Furnace Engineering Company, Inc., New York, N. Y.—1,636,693.

Extraction Method and Apparatus. Hambden Buel, Fairview, N. J., assignor to International Patents Development Company, Wilmington, Del.—1,636,550.

Process for Extracting Fats from Textiles. Albert Beil, Hochst-on-the-Main, and Wilhelm Adolf Meyer, Hersfeld Germany, assignors to A. Rechberg Gesellschaft mit beschränkter Haftung and Georg Braun Gesellschaft mit beschränkter Haftung, Hersfeld, Germany.—1,636,351.

Concentrator for Liquids. Wilhelm Vogelbusch, Vienna, Austria.—1,637,431.

Process of Separation of the Elements of Air or of other Gaseous Mixtures by Liquefaction and Rectification. Jean Le Rouge, Boulogne, France, assignor to Societe l'Air Liquide (Societe Anonyme pour l'Etude et l'Exploitation des Procedes Georges Claude), Paris, France.—1,638,005.

Fibrous Material and Method of Making the Same. Carl Hering, Philadelphia, Pa. —1,636,511.

Recovery of Values from Nitrocellulose Material. Carleton Ellis, Montclair, and Harry M. Weber, Bloomfield, N. J., as-

NEWS of the Industry

Agricultural Raw Materials Being Investigated

UNDER A NEW appropriation, effective July 1, the Bureau of Standards has just organized several new investigations of raw materials which give promise of serving industries effectively, thus becoming valuable items of commerce instead of waste products as at present. Among the investigations being actively pressed by the Bureau is a co-operative study on the making of wall board from cornstalk fiber. This project contemplates the chemical engineering development on a semi-works scale of a process which has been investigated in the laboratory of Prof. O. R. Sweeney, of Iowa State College. The Bureau will furnish several assistants and some of the chemical engineering equipment for work to be done at Ames, Iowa, under a general co-operative arrangement to determine effective works methods and probable manufacturing costs for this type of wall board.

Another major project is the investigation of the composition of waste materials from the cotton industry, particularly cotton-seed hulls and cotton burrs. Dr. K. S. Markley has transferred from the Bureau of Chemistry to become an associate chemist at the Bureau of Standards participating in this work. He will be associated with W. T. Schreiber, who has been transferred from the textile section of the Bureau to these waste-materials studies. Schreiber and Markley will begin their investigations by a comprehensive study of the composition of cotton wastes and of possible reactions for utilization of the constituents found.

Recent additions to the Bureau staff who will work on other problems in Washington include also Dr. S. F. Acree, who will investigate methods for making organic acids from peanut hulls.

Largest Carbide Furnace for Shawinigan Falls

THE CANADA CARBIDE CO., a subsidiary of the Shawinigan Water and Power Co., will soon have the largest carbide furnace on this continent. The capacity will be approximately fifty per cent greater than the present furnace. The new equipment will cost $250,000. Canada carbide is one of the largest power users of the group of electro-chemical industries located at Shawinigan Falls in close proximity to the power developments on the St. Maurice River. It has been utilizing over 30,000 horsepower in the manufacture of calcium carbide, a large portion of which is converted into acetylene gas and sold to Canadian Electro Products Co., Limited, another Shawinigan subsidiary, for manufacture into various chemicals. The latter company began business during the war to produce acetone, required by the munitions authorities. It now produces acetaldehyde, acetic acid and other chemicals.

The installation of the new furnace by Canada Carbide will no doubt mean the utilization of an increased amount of hydro electric power and the further development of Shawinigan Falls as one of the most important electro-chemical centers on the continent.

Acid Extraction Process to Obtain Aluminum

STUDIES FOR the development of acid extraction processes leading to cheaper methods for the obtaining of aluminum metal from clays and other aluminum silicates which are very abundant in nature have been completed by investigators of the United States Bureau of Mines, Department of Commerce. The amount of low-silica bauxite, from which aluminum is at present principally obtained, available at low cost in the United States, is not large, the Bureau points out, and imports of bauxite used by the American aluminum industry are increasing. Many power sites of the western Intermountain region could produce aluminum cheaply if a satisfactory source of aluminum oxide were available.

Higher Duty on Fluorspar in Prospect

In view of the testimony submitted at the Tariff Commission's hearing on July 22 and 23, particularly when considered in conjunction with the Commission's own findings as to production costs, it seems likely that an increase in the duty on fluorspar will be recommended. If it should be shown, however, that some of the items making up the domestic cost of production are too high, it is possible that the maximum increase of fifty per cent may not be found warranted.

Electrochemists Will Visit Metal Centers

THE AMERICAN Electrochemical Society has arranged a trip through the Northwest, affording members an opportunity to see the very latest developments in the production of the pure metals starting from the minerals. The great mines, smelters and refineries of Trail, B. C., Anaconda, Wallace, Kellogg, Butte, and Great Falls will be visited and competent guides furnished to conduct the party through the plants.

A special A. E. S train will start from Chicago on September 4th, returning on the 21st. The first stop is scheduled for Minneapolis, where the first scientific session will be held. Two other scientific sessions are included in the program one at Vancouver and the other at Keokuk. Important papers on such timely subjects as the Electrodeposition of Rubber and Thin Film Rectifiers are among those to be presented.

The complete itinerary also arranges stops to visit industrial plants and power developments at Spokane, Seattle, Vancouver, and Keokuk. The new 7-mile tunnel being bored through the Cascade Mountains will be inspected, as well as the Oil fields at Shelby. One day will be spent at Glacier National Park.

Photo-Electric Cell Used in Paper Manufacture

ONE of the large paper mills at Kalamazoo, Mich., is experimenting with the use of the photo-electric cell, a development heretofore used primarily in connection with television activities. At the paper mill, the experiments are being carried out under the direction of Prof. Paul Rood of the Western State Normal School, Kalamazoo, in connection with studies for the use of the photo-electric cell in industrial operations. The instrument is being employed to regulate the thickness of paper as it travels through the rolls in manufacture. As the paper flows through the rollers, the apparatus is sensitive to the amount of light coming through the paper, or to the transparency of the paper roll. Any variation in the thickness of the paper stock causes a change in its transparency, and this change in light density, with the use of the photo-electric cell, sets up contact and regulates the paper flow back to normal thickness.

Students Course Arranged for Chemical Show

A STUDENTS course on fundamentals of chemical engineering and industrial chemical practice has been arranged as a part of the Eleventh Exposition of Chemical Industries. There will be two divisions, one comprising students who are advanced in chemical engineering and have had sufficient training or experience to understand how chemical equipment is made and works, and another section made up of students who have not had the opportunity or experience in unit practice or processes and their method of operation.

General lectures will be given on each day for four days beginning Tuesday morning September 27 as follows:

Arthur D. Little, "Ethics and Ideals of the Chemical Profession"; H. C. Parmelee, "What the Chemist and Engineer Reads"; H. E. Howe, "What the Chemist and Engineer Writes"; Williams Haynes, "How the Products Chemists make are Sold."

The subsequent lectures, going into the detail of unit practices for section one, will be of a more elementary nature and will illustrate and confine to the simplest possible statement the principles involved and descriptions of typical apparatus.

THE MANAGEMENT of the exposition announces that when the doors open at the Grand Central Palace, September 26, there will be from 350 to 400 exhibits, many of which will be shown and discussed for the first time. In addition to the exhibits the various chemical societies which will meet here during the exposition, are closely cooperating with the management to make this exposition the greatest in its history.

The Fifth Chemical Industries Banquet will be held during the exposition on September 28, under the auspices of the Salesmen's Association of the American Chemical Industry at the Hotel Roosevelt. About fifteen associations and societies of the chemical industry co-operating with the exposition management will attend the banquet.

Standard Oil Buys Rights in Bergius Patents

THE STANDARD Oil Co. of New Jersey has confirmed reports emanating from Europe to the effect that the company had successfully concluded negotiations with the I. G. Farbenindustrie Aktiengesellschaft of Germany for the Mutual use of processes for manufacturing synthetic motor fuel controlled by the Bergius patents.

The reports had stated that Walter C. Teagle, president of the Standard Oil Co. of New Jersey, reached an agreement with representatives of the German Dye Trust by which these industries will mutually share in the utilization of the Bergius patents for the manufacture of synthetic gasoline from coal. A corporation, to be known as the Deutsche Gasoline Co., has been formed to sell the synthetic fuel. "I G" will hold half the shares in this corporation, the remainder being divided equally between the Standard Oil Co. of New Jersey and the selling company.

International Congress for Testing Materials

THE INTERNATIONAL Congress for Testing Materials at Amsterdam, September 12 to September 17, 1927, is the first manifestation after the war of international co-operation on the subject of testing materials.

The subjects to be treated at the Congress are divided in three sections: metals; cement, concrete, stone and bricks; miscellaneous, (oils, rubber, wood, etc.).

In each section twenty-seven papers will be presented. The papers will be pronounced in English, French or German. With regard to the limited time, the speeches will not be translated during the sessions. Complete program will soon be issued.

New Duty on Cresylic Acid May Affect Imports

UNDER DATE of July 24 the President issued a proclamation under the provisions of Section 315 of the Tariff Act of 1922, decreasing the duty on refined cresylic acid from 40 per cent ad valorem upon the basis of the American selling price, as defined in the Tariff Act, and 7c. per lb. to 20 per cent ad valorem upon American selling price and 3½c. per lb.

Crude cresylic acid has been on the free and there is change in its tariff status. The new duty on the refined has aroused considerable speculation relative to its effect on imports, not so much from a quantity standpoint as from a consideration of the quality of importations. While the higher duty was in effect it is stated that a large part of imports arrived in a condition to be classified as crude and thus became duty exempt. Subjected to some refining this material was marketed as refined cresylic acid.

John V. Dorr Establishes Prize in Metallurgy

John Van Nostrand Dorr, president of the Dorr Company, has established, at the South Dakota School of Mines, a prize of $100 in cash to be awarded each year. The prize will be given to that student in metallurgy who by work accomplished, character and general fitness, gives promise of high accomplishment in the metallurgical field. In the development of the mining and metallurgical interests of the Black Hills of South Dakota, Mr. Dorr was formerly very active. It was in this district that the Dorr Classifier and Dorr Thickener were first introduced.

Larger Potash Production in Spain

A REPORT FROM Consul C. A. Henry at Barcelona states that construction and development work were reported to have been active during 1926 at the mines of Suria in the Province of Barcelona. For some unexplained reason, however, production has not yet reached the volume that was predicted sometime ago. In 1925, 27,734 tons of potash salts, valued at 3,853,450 pesetas were mined, and it is probable that this figure was exceeded by a considerable margin in 1926.

According to a royal order published in January, 1927, production during the current year is to be not more than 60,000 tons of potash salts on the basis of 80 per cent potassium chloride, while the minimum production is not to be below 15,000 tons. The maximum price for the national market is fixed at 250 pesetas per ton, f.o.b. cars at mine mouth, while the minimum export price must be at least one per cent higher than that prevailing in Spain during the previous month.

Obligatory Use of Alcohol Proposed in Hungary

A REPORT to the Department of Commerce states that the Hungarian Minister of Finance submitted to Parliament on June 10 a bill for the obligatory admixture of alcohol to mineral oil products used for motor fuel and to fix the price of alcohol to be used for this purpose. This admixture of alcohol should not, however, have the effect of increasing the price of motor fuel. An admixture of probably 15 to 20 per cent of alcohol is considered. The Hungarian alcohol industry is working below capacity, and is dumping abroad a considerable proportion of its production for lack of a home market.

Alum Production Proposed for the Argentine

ADVICES FROM H. Bently MacKenzie, assistant commercial attache at Buenos Aires says that the Argentine Ministry of Public Works has approved a project of the Sanitary Works Department to install a plant at San Isidro to produce 270 metric tons daily of alum, for Buenos Aires water purification, at an estimated cost of about $850,000 and a 150-metric ton plant of the same kind at the Recoleta at an estimated cost of $430,000. San Isidro is a suburb of Buenos Aires in the Province of Buenos Aires.

Hearing on Rosin Standards

A hearing on proposed standards for rosin in which the predominating color is red will be given by the Food, Drug and Insecticide Administration to all interested parties on November 1, 1927, according to a recent announcement by the Acting Secretary of Agriculture.

NEWS FROM WASHINGTON

By Paul Wooton
Washington Correspondent of Chem. & Met.

THAT THE chemical industry would like to see a further expansion of services which can be performed only by the government is becoming increasingly evident. There is a demand for the expansion of both the foreign and domestic services being performed by the Department of Commerce and for a continuation of the effort to combat unfair control abroad of essential raw materials consumed in this country.

The success which has attended the work of special trade commissioners abroad in behalf of the textile, tobacco, lumber, automobile and other industries has created a demand in the chemical trade for similar aid. It is believed that the foreign trade in chemicals has become of sufficient importance to justify the appointment of special chemical trade commissioners to Europe, to Latin America and to the Far East. The testimony of officials of the Department of Commerce before the appropriations committees of Congress indicates very clearly that they believe that the staff of commodity trade commissioners could be enlarged considerably to the very great benefit of the industry concerned and of the general public. The cost of maintaining a trade commissioner abroad is $15,000 annually. In addition to salary, this represents overhead, travel and other expenses. These commissioners spend most of their time traveling from one commercial center to the other. Their intimate knowledge of the commodity in which they specialize enables them to gather a large amount of first-hand information and, in addition, they are able to stimulate the interest of consuls and other representatives of the government abroad to keep in close touch with developments of interest to the particular American industry which they are serving.

The needs of a domestic character are more numerous. There is a demand for a census of distribution; for regional surveys; for codes of business ethics; for the standardization of trade terms and practices and for the extension of simplified practices work.

As the world's major consumer, the United States must be on guard constantly against unfair practices looking to price increases. Two years ago, Congress was influenced by excessive rubber prices to appropriate rather liberally for an investigation which covered some twenty essential raw materials subject to various types of control. The increasing tendency on the part of foreign producers of chemical raw materials to resort to various methods of gouging the American consumer has led many to believe that the Department of Commerce should continue investigations along those lines.

COOLER WEATHER this summer is given as a possible reason for the scarcity of menhaden in the coastal waters of the North Atlantic. As a consequence, the forty factors which ordinarily produce 7,000,000 gallons of oil and 85,000 tons of fish meal and scrap are facing a serious situation. The Bureau of Fisheries has been asked to investigate and make a report on the subject. At the Bureau, it was stated that the scarcity of menhaden is not likely to be permanent. Variations in the migration of all fish occur at times, it was stated.

Western carriers have decided to withdraw their recent proposal for classification changes, the effect of which would have been to increase the rates on returned-empty containers. This action followed a protest by representatives of the traffic committee of the Manufacturing Chemists Association. They pointed out that manufacturers of alcohol and other chemicals had gone to heavy expense to develope special round-trip containers on the understanding that rates favorable to their use would be maintained.

With the discontinuance of the advisory committee of the National Fertilizer Association and the transfer of its duties to the district committees, the importance of these groups, in the association's scheme of organization, is greatly increased. This action was taken at the meeting of the Board of Directors at a meeting in Washington July 18. The membership of the district committees as revised at the Washington meeting of the directors is shown in the lists published elsewhere in this issue.

The directors discussed at length the items of the code of trade practice adopted Jan. 10 and decided to have each district committee call a meeting for the discussion of the code. The directors will do all in their power, it was stated, to secure complete compliance with the code. The next meeting of the Association will be held in Atlanta Nov. 7-10.

LESS INDUSTRIAL alcohol is being diverted for beverage use than at any time since the enactment of the Volstead law, reports to the Bureau of Prohibition show. A variety of causes is thought to be responsible for this improvement. Supervision is in the hands of more capable men than ever before. Enforcement machinery has been made much more effective. The revision of formulæ has made it much more difficult to recover a quotable product from denatured alcohol. Much credit is given the use of aldehol as a denaturant. It also is emphasized at the Bureau that much credit is due to legitimate manufacturers and dealers for their co-operation in securing the elimination of illegal operations under the cloak of respectable business. The scarcity of alcohol in bootleg channels, with a consequent sharp upturn in the price, is cited as a good barometer of the effectiveness of enforcement.

The Chemical Division of the Bureau now is giving much attention to new denaturants. The great success which has followed the use of aldehol as a complete denaturant has stimulated research on the denaturants for special purpose. There are eighty such denaturants in use. It is known that a number of them are susceptible of manipulation, but because of the special use of the article, difficult limitations are placed on the denaturants that may be used. Gasoline, for instance, may not be used as a denaturant in a perfume or other toilet preparation. The denaturant must be odorless and must not react with the essential oils used in the preparations. Despite these limitations, decided progress is being made in the development of denaturing compounds which are inactive chemically. As these are perfected they will be substituted for the denaturants which are easily removable.

Drilling now is in progress on the Bureau of Mines' fourth potash well. This well, which is in Ector County, Texas, will be drilled to a depth of 2,000 feet. It is expected that the drill will reach the salt bed at a depth of 1,000 feet.

The third well, which is in New Mexico, is fifty per cent complete. Leases now are being negotiated with the land owners on four additional sites selected by the U. S. Geological Survey. Two of these sites are in Upton County, one in Crane County, and one in Crockett County.

AN EFFORT to transfer the administration of the Webb-Pomerene Export Trade Act to the Department of Commerce is expected at the forthcoming session of Congress. Since its enactment the law has been administered by the Federal Trade Commission. There is a feeling that the attitude of the majority of that Commission has not been in sympathy with the law and as a result the purpose of the act to promote the export trade. Instead the tendency has been to be inquisitorial and arbitrary. Now the Commission has abolished its export trade division and has placed the work under the immediate direction of its chief counsel.

Despite the attitude of the administering body, fifty-six associations operating more than 1,000 plants now are functioning under the law and a dozen more are in process of formation.

If Congress puts the export association work in the Department of Commerce where a friendly and helpful environment is assured, it is expected that the list will grow longer quickly.

Marketing Agreements Discussed By British and Germans

Plans for International Distribution of Dyestuffs May Be Evolved—American Firm Loses Patent Suit

FROM OUR LONDON CORRESPONDENT

THE ANNUAL MEETING of the Society of Chemical Industry passed off as anticipated. Next year the society is to visit America and there will be difficulty in finding enthusiasts to incur the necessary expenditure and the best that can be hoped for is that twenty or thirty people will help to swell the total of the chemical engineers who will make the journey at about the same time for the convention at Quebec of the American Institute of Chemical Engineers. Next year, therefore, a kind of second class meeting for the benefit of home members will probably be arranged and 1929, and 1931, when the society attains its jubilee, will presumably be distinguished by special efforts. Colonel Pollitt's lecture on the nitrogen industry gave some interesting details about the Billingham factory and was a model of concise and clear description.

One of the points touched on in this lecture related to the necessity of Synthetic Ammonia & Nitrates Limited making their own high pressure joints and measuring instruments. This has been and will continue to be a sore point among chemical plant manufacturers, because there is a tendency for large combinations to follow the example of the German I.G. and to make use of their surplus buildings for the manufacture of machinery. There is an obvious advantage in being able to carry out one's own repairs, but it is already clear that something much more ambitious will be attempted during the next few years and the services of chemical plant manufacturers will be utilized mainly as a stand-by.

THE DISCUSSIONS between I.C.I. and the German I.G. have been proceeding systematically and probably the time is not distant when some preliminary understanding will be reached regarding international markets. It seems doubtful whether this will be on a comprehensive scale, as neither the public nor the chemical industry are fully educated to the idea, but it may be that in the dyestuffs field, something more tangible and definite will materialize and it is believed there will be no swerving from the definite view that further development of the British dyestuffs industry must be fully safeguarded.

A patent case of unusual interest has just been concluded after a hearing lasting for seventeen days, the plaintiffs being Messrs. Sharpe & Dohme, Inc., of the United States, and the defendants Boots' Pure Drug Co., Ltd., the well-known British chemists organization. It was alleged that Messrs. Boots had infringed an English patent granted to Messrs. Sharpe & Dohme for the manufacture of hexyl resorcinols. Judgment was given for Messrs. Boots, and the patent was held to be invalid on account of prior publication being of such a nature that no inventive act was necessary to make the preparations for which a monopoly was sought. The judge considered that a patent was too great a reward for merely verifying the work foreshadowed but not actually carried out by others and that if such patents were valid, it would be a very serious matter for the chemical industry. Evidence was given for the plaintiffs by Sir William Pope and Horatio Ballantyne and for Messrs. Boots by Dr. Otto Oberländer and Prof. Thomas Gray, of Glasgow University.

THE PUBLIC and the industry are still taking stock of the coal situation, which has not developed at all favorably. The fact is that during the British coal strike European countries materially enlarged their output and have endeavored to maintain it since. The British coal industry had committed itself to a system calculated to give increased output at lower cost, but the elasticity of the system depends upon selling prices remaining above certain levels and foreign competition has nullified the advantage which was anticipated and the problem of 1925 is to all intents and purposes with us again. Next year, the world's coal trade will probably face a period of strenuous competition and thereafter possibly international devolopments in carbonization and liquefaction of coal will play an important part. This is foreshadowed by the report for 1926 just issued by the British Fuel Research Board, which is worthy of very close study. The work done at Greenwich appears to be of a high order, intelligently directed and on a scale at least equal to that shown in any other country. The commercial installation by a subsidiary company of low temperature retorts designed by the Fuel Research Board has been definitely decided upon and the Gas Light & Coke Co. will act as the managers for the Fuel Production Co., Ltd., the capital of which has been guaranteed under the Trades Facilities Act. The one ton per day Bergius plant has been running continuously and has shown that British coal is admirably adapted for treatment. A detailed investigation of pitch and other binders, such as "pulp" binders, is being undertaken and briquetting prior to carbonizing may ultimately prove of importance. In general, it has been abundantly proved that the Fuel Research Board will ultimately play a most important part not only in the scientific and economic but also in the national aspects of the utilization of fuel in the Empire.

THE BRUNLER Syndicate Ltd. has just been registered as a private company with a capital of about $200,000 and for the purpose of adopting an agreement with O. Brunler and Dr. W. R. Ormandy. The Brunler boiler and the methods of burning fuel under water with air enriched with oxygen have been described in the "Industrial Chemist" and it is understood that the process may also prove suitable for the evaporation of sewage sludge, wood pulp sulphite residues and even for the manufacture of calcium nitrate by combustion of gases under water. An experimental plant has been installed at the Gas Light & Coke Co.

An interesting suggestion is made in the Annual Report of the British Science Guild, a scheme being outlined for a science news agency. Previous attempts by technical societies have usually failed because the editors or organizers were scientific experts and editorial amateurs. It is estimated that with one hundred annual subscribers of $200 per annum, the minimum annual expenditure would be covered and that a sum of $50,000 in the form of a guarantee would be needed to cover initial outlay and the risk of having to operate for three years before paying its way.

EDITOR'S NOTE—Inquiry at the Custom House in London, and at the offices of the British Board of Trade indicated as inaccurate the statement made in this correspondence in June, 1927, to the effect that "propyl alcohol, isopropyl alcohol and butanol have been provisionally placed on the duty-free list." All three of these commodities are still dutiable when imported into Great Britain.

Central Sales Building for German Dye Trust

THE PURCHASE of land in Frankfort is contemplated by the I. G. Farben-industrie A. G. for the purpose of centralizing the sale of dyes, according to W. T. Daugherty, trade commissioner at Berlin.

He reports that contemplating erection of a general administration building centering also its dyestuff sales, I. G. Farben-industrie A. G. proposes to purchase a tract of 100,000 square meters in a northwest section of Frankfort.

The I. G. centers its dyes sales now in four locations, selling different world markets. Ludwigshafen sells Hungary, Rumania, south Slavia, Switzerland, interior India, Turkey, Greece, Africa and Bulgaria; Cassella, Frankfort-on-the-Main, France, Belgium, Luxemburg, Italy, Spain, Portugal, England, the Saar, South America, Australia, and New Zealand; Hoechst, Sweden, Norway, Denmark, Austria, east Europe, Czechoslovakia, North and Central America; Leverkusen, Germany and Holland.

Franco-German Commercial Agreement Centers on Tariffs

Temporary Treaty Reported as Probable on Basis of Most Favored Nation Duties

From Our Paris Correspondent

THE LOWER Chamber of the French Parliament having refused to act favorably on the new customs tariff, Germany at first refused to extend the commercial temporary agreement which was to end on June 30. At the eleventh hour the Germans agreed to extend the special agreement dealing with the commercial exchanges of the Sarre territory. Germany, it is said, is ready to sign a new temporary agreement on condition that France accepts a commercial convention on the "most privileged nation" basis with the lowest present customs tariff.

Should the German demand be granted the French industries would have to meet very serious problems. The French chemical industry would not be directly threatened so far as the organic industry is concerned as it is still protected by the convention governing German coloring matters entering France up to August 15, 1928. The most affected chemical industries appear to be the mineral industry and especially the fertilizer industry. This may be gathered from an article of Prof. Moureu in one of the leading French daily papers "Le Journal" who brings this question to the attention of the public. As public opinion is not to be moved or interested by such problems it may be safely said that Professor Moureu's alarm is the forerunner of a press campaign intended to influence the government.

INTERESTING information was given at the general meeting of the Ketol Co. shareholders on June 27. The Ketol Co. uses the Lefranc process starting from sawdust as raw material. The Saulcys Meurthe works now under construction will be ready in the course of 1928. These works are to give a daily output of 3,000 liters of ketol. The society also intends to erect new plants at La Cluse where large quantities of sawdust are easily available.

Detailed technical information was also given to the shareholders. At its present cost pure ketol cannot be used as a motor fuel but when it is added to other carburants in a proportion of 5 to 10 per cent most interesting results are obtained. Ketol also acts as an anti-knock when mixed with motor fuels thus allowing a higher compression in motors. Ketol also is an exceedingly good solvent for nitrocellulose.

The principal manufacturers of benzol of France have formed a trade union called "Union Française des producteurs de benzol." The union's aim is to record technical progress in the production and use of benzol and to devise ways for increasing the use of this product. The production of benzol has been steadily increasing since the gas plants are compelled to debenzolize their whole gas production. The French benzol production which reached 23,000 tons in 1923, increased to 54,000 tons in 1925. It seems however, that when all gas plants have been equipped for the recovery of benzol, production will not exceed 90,000 tons per year.

WITH A large surplus production of straw in France, attention is being given to the practicability of using it as a raw material for manufacturing cellulose.

Chemically speaking cellulose made from straw is as good as the best cellulose made from wood. Cellulose from straw is usually obtained by boiling under pressure with caustic soda. To be remunerative, however, the caustic soda should be recovered by evaporation, calcination and causticization of the waste soda. Big Plants with a daily output of 20 tons are necessary for the use of such process.

Mr. de Boistesselin, chairman of the Committee of Chemistry of the Industrial Society at Rouen, foresees a profitable manufacture of cellulose from straw. Nitric acid is used in this new process and cellulose thus obtained is of fine quality. Husks of wheat straw, stems and knots included, will yield a bleached cellulose of 37 per cent of the initial weight of the raw material. Before being bleached this cellulose is negative to the phloroglucine test and shows a copper index of 2.7. After bleaching, which is easily done, the phloroglucine test is repeated and is a fortiori still negative there are no sig;ns of oxycellulose in the cellulose thus treated by the methylene blue. Ashes are in a proportion of 1.57 per cent and the copper index is 3.18.

U. S. Company Acquires Swiss Quenching System

GEORGE E. LEARNARD, President of the International Combustion Engineering Corporation has announced the acquisition from Sulzer Brothers, Winterthur, Switzerland of the Sulzer System for dry quenching coke, which was described in *Chem. & Met.*, Oct. 13, 1924, pp. 574 and 575, which will be developed in this country by a new subsidiary, Dry Quenching Equipment Corporation.

The Sulzer System is widely used in Europe for cooling coke without the use of water. Steam is produced for power and plant purposes during the cooling process, thus diverting to useful work the sensible heat of the coke, which is at present lost by wet quenching.

It is also announced that directors of the International Enginering Corp. and of the F. J. Lewis Manufacturing Co., have approved plans for a consolidation of the two companies.

Italian Chemical Industry Shows Development

GREAT ADVANCES have been made by the chemical industry in Italy since pre-war days, particularly in the field of fertilizers, organic dyes and rayon, according to an address made by a leading Italian chemical firm manager in Milan.

This address as reported to the Department of Commerce stated that Italy manufactured 16,000 tons of calcium cynamide in 1914, containing 3,000 tons of nitrogen, and this amount represented the entire national production of nitrogenous inorganic fertilizer.

Since the World War, the synthetic nitrogen industry has come into existence in Italy and has undergone a rapid expansion within the past few years, so much so that in 1925 Italy's production of synthetic nitrogen was estimated at 17,000 tons and it is expected that by 1928 the domestic production of synthetic nitrogen will have reached 40,000 tons.

To the synthetic nitrogen produced in 1925 must be added 37,750 tons of calcium cyanamide, 900 tons of ammonium nitrate and 30,000 tons of ammonium sulphate. Production of calcium cyanamide shows a gain of 143 per cent over pre-war output.

Italy produced 925,100 tons of acid phosphates in 1914, whereas in 1926 production has risen to 1,504,000 tons, or a gain of 32 per cent. The increased production of acid phosphates was accompanied by a rise in the output of sulphuric acid which increased from 770,000 tons in 1913 to 1,075,000 tons in 1925.

Before the war Italy produced no organic dyes. This industry was created during the war and in 1925 the Italian dye industry produced 4,990 metric tons of intermediates and 6,910 metric tons of artificial dyes, of which 4,910 metric tons were represented by sulphur dyes alone. The domestic output now covers more than 50 per cent of the needs of the local textile industries.

Italy now holds second place as a world producer of rayon, having manufactured in 1926 17,000,000 kilos of rayon as against only 1,000,000 kilos in 1914.

It is estimated in Italy that over 4,000,000,000 lire are invested in the Italian chemical industry, of which 2 billion in the rayon industry, one billion in the fertilizing industry and the remaining billion distributed among the various other branches of the chemical industry. The industry employs from 130,000 to 140,000 workers and uses energy to the extent of more than 250,000 up.

News in Brief

THE U. S. PHOSPHORIC Products Corporation, of New York, has filed a complaint with the Interstate Commerce Commission contending that freight rates on acidulated phosphate rock from East Tampa, Fla., to points in Ohio, Indiana, Michigan and Illinois are unreasonable and give an undue preference to shippers from Anaconda, Mont., to the same destinations.

THE SOUTHERN COTTON OIL CO., New Orleans, La., is said to be perfecting a new substance from cottonseed and has entered into commercial production for the material. It has the appearance of rubber and has been found to be admirably adapted for roof preservative service. The material, it is stated, contains no tar or asphalt, and is not affected by the rays of the sun.

THE JOHNS HOPKINS University, Baltimore, Md., will accord the degree of bachelor of science for the successful completion of work in night technical courses at the institution, beginning with the 1927-28 school year. The degree will hold equal status for that given for day courses and presents a distinct departure in scholastic work in this section.

THE CONTENTION of the Bakelite Corporation that freight rates on crude cresylic acid from Philadelphia to Perth Amboy, N. J., are unreasonable has been upheld by Interstate Commerce Commission Examiner E. H. Kerwin. He has presented a reasonable schedule of rates for the Commission's approval.

THE EDISON BOTANIC Research Corporation, West Orange, N. J., has been organized by Thomas A. Edison and associates with capital of $75,000, to carry out extensive research and investigations in the line of raw and manufactured rubber. The new organization is perfecting plans for a series of important experiments, following preliminary work relative to rubber culture, etc., Which Mr. Edison has been carrying out for a number of months. The laboratory will be located at the West Orange plant of the Edison interests. The new company is headed by Mr. Edison, John V. Miller, Charles Edison and Ralph H. Allen.

A PROPOSAL has been placed before the Board of Trade of New Westminster, British Columbia, for the establishment in that city of a plant to convert waste sawmill products into high-grade charcoal for briquette fuel and poultry food. J. F. Shelton, general manager of the People's Fuel Company, Bellingham, Washington, who paid a visit to New Westminster recently, outlined the process employed by his company which permitted carbonization of sawdust and other mill waste as well as low-grade coal.

THE METAL and machinery industries are prominently represented in a group of forty-one leading business executives who have organized an Advisory Board of the American Management Association, feeling that improved management methods are essential in maintaining present prosperity and that knowledge of such methods should be spread more quickly throughout business. Both production and distribution will be included in the scope of the board, which will serve in guiding the policies of the Association and in focusing its increased research facilities on pressing industrial problems.

THE FIRST National Fuels Meeting arranged for all engineers who are interested in the use and conservation of fuels, will be held at St. Louis, October 10-13. The meeting has been arranged by the Fuels Division of the American Society of Mechanical Engineers and is sponsored by many technical and trade organizations.

Gain in Export of Chemicals in First Six Months

THE United States exports of chemicals and allied products attained the high figure of $97,188,000 during the first six months of 1927, an increase of 15 per cent over the first six months of 1926, while the imports of $103,936,000, although higher than in some of the preceding years, were 11 per cent below those of the corresponding period a year ago, according to the chemical division of the Department of Commerce.

The improvement in exports was rather general in most of the groups, the largest, 97 per cent, being in coaltar products—especially in crudes. Other notable increases were in industrial chemicals and pigments and paints, while the fertilizer, medicinal and toilet preparation groups were about holding their own.

W. J. Joachim Receives Rudolph Diesel Award

ANNOUNCEMENT is made that W. F. Joachim, of the Langley Memorial Aeronautical Laboratory has been selected to receive the Rudolph Diesel Award for 1927, consisting of a suitable certificate and a cash prize of one hundred dollars, for his paper entitled "Oil Spray Investigations of the National Advisory Committee for Aeronautics," which was presented at the Oil Power Week meeting, April 21-23, 1927, at Pennsylvania State College.

The Rudolph Diesel Award, established in honor of the man whose name is so closely connected with the modern oil-engine, is given annually in connection with the activities of Oil Power Week, for the best written contribution toward the advancement of oil engines delivered at any of the meetings held throughout the country. In this year's celebration of Oil Power Week, 106 meetings of national technical societies were held in 31 states; 88 different papers were presented, all of which had been especially prepared for the occasion.

German Dye Shares Admitted to Stock Market

FOLLOWING the recent publication of its balance sheet, the greater part of the new 258,400,000 marks common shares of I. G. Farbenindustrie issued at the time of the capital increase to 1,100,000,000 marks on Sept. 1, 1926, has been admitted to trading on the Berlin Stock Exchange, according to advices from Trade Commissioner William T. Daugherty, Berlin.

The I. G. issued three series of shares to cover its capital increase from 646,000,000 marks common and 4,400,000 marks preferred. They were, first, 258,400,000 marks new common; second, 160,000,000 marks new 6 per cent preferred series A; and third, 35,600,000 marks 3½ per cent series B with tenfold vote rights.

The common shares now admitted to the Berlin Bourse amount to 211,080,000 marks, of which 16,333,000 marks pay dividends from January 1, 1926, and 192,746,800 marks pay dividends from Jan. 1, 1927. The I. G. made application to the Berlin Bourse for admission of these shares last February, but the bourse direction reserved its permission until after the I. G. balance sheet was published.

The remaining 47,320,000 marks shares included in the total 258,400,000 marks issue remains in reserve for probable further transactions.

The new issues are reported intended to finance increasing sales and building extensions incident to the acquisition of new properties, as well as improvements of old, such as the Leunawerke, where new calcium nitrate and "Nitrophoska" units have been erected; also the mammoth "oil from coal" plant. Improvements in progress at the I. G.'s two air fixation plants at Leuna and Oppau will increase fixed nitrogen production capacity to 500,000 tons primary nitrogen annually.

Pacific Trade Exhibition to Australia

Extensive preparations have been going on for several weeks for the first Pacific Trade Exhibition which was recently shipped aboard the steamer "Roxen" for the five leading Australian Ports: Sydney, New Castle, Melbourne, Adelaide and Brisbane. Under the management of MacDonald & Co. of San Francisco, a large variety of American products will be displayed to buyers and the public in these ports.

No Duty on Nitrate Bags

Bags of hemp, jute, and other similar vegetable fibers for packing nitrate have been exempted from import duty by a recent Chilean decree, the Commercial Attache at Lima, O. C. Townsend, has cabled to the Department of Commerce. The former rate of duty was 0.03 peso ($.0036) per gross kilo.

MEN *you should know about*

ROBERT P. RUSSELL, formerly assistant professor of chemical engineering in the Massachusetts Institute of Technology is now director of research for the Standard Oil Co. of Louisiana, Baton Rouge. Mr. Russell is familiar to the profession as co-author with R. T. Haslam of the book "Fuels and Their Combustion."

EDWARD R. WEIDLEIN, director of Mellon Institute of Industrial Research of the University of Pittsburgh and president of the American Institute of Chemical Engineers, will spend September and October in visits to European educational institutions, research laboratories and chemical works. While abroad he will also confer with a number of educationists and laboratory directors regarding various problems in industrial research organization and management. Dr. Weidlein plans to depart for England on August 31 and to remain there for about two weeks. His continental trip through Germany, Switzerland, Italy and France will follow.

PAUL D. FOOTE has resigned from his position on the physical research staff of the Bureau of Standards to become research physicist of the Gulf Production Company. This company is establishing a new research laboratory in Pittsburgh for the study of fundamental problems affecting production of petroleum. These laboratories will be temporarily located at Mellon Institute, where Dr. Foote will take up his work during August.

A. ANABLE, for several years connected with the equipment sales department of The Dorr Co. has been appointed director of publicity for the company.

F. A. ERNST of the Fixed Nitrogen Research Laboratory has resigned to join the Atmospheric Nitrogen Co. at Syracuse, N. Y.

H. A. MOFFAT is chemical engineer for the Milwaukee Coke and Gas Company.

THEODORE W. SILL has recently become vice-president of the Osborn Development Company, New York City, which is engaged in supervising the commercial development and exploitation of patented processes. Mr. Sill was formerly vice-president of The Forhan Company, with which company he is still associated. He has been connected with the chemical industry for the past sixteen years, having formerly been secretary and treasurer of E. C. Klipstein & Sons Company.

GEORGE E. KEPPEL is now on the research staff of the Atmospheric Nitrogen Corp., Syracuse, N. Y.

EARL D. STEWART, formerly research chemist for the Exchange Research Laboratory of the California Fruit Growers Exchange at Corona, Calif., is now chief chemist for the Douthitt Engineering Co. of Chicago.

R. R. BURNS is now employed by the Tennessee Copper Co.

HARRY P. TREVITHICK, official consulting chemist to the New York Produce Exchange and referee chemist in

HARRY P. TREVITHICK

New York for the Interstate Cottonseed Crushers Association, has been elected president of the American Oil Chemists' Society for the year 1927-1928.

E. R. RAMSEY, formerly sales manager of the metallurgical division of The Dorr Co., Denver, is now assistant general sales manager with headquarters in New York. A. D. Marriot succeeds Mr. Ramsey in Denver. A. T. Hastings has been appointed assistant manager of the metallurgical division sales with headquarters at the Los Angeles office.

H. D. HOLLER, who has been for the past two years engaged on a special investigation for the Phillips Petroleum Co. has completed his work with that concern and returned to the chemical research staff of the Bureau of Standards. Dr. Holler will be engaged on special studies of the fundamental principles affecting soil corrosion of pipe and sub-surface metal structures.

SAMUEL F. WALTON has joined the technical staff of the Exolon Company, Blasdell, N. Y. and Thorold, Ontario, in the capacity of ceramic engineer.

A. H. MILLER of Casper, Wyoming, has severed his connection with the Rocky Mountain Division of the Standard Oil Company of Indiana, to accept the position of mechanical superintendent of the Patinyo Mines and Enterprises Consolidated of Oruro, Bolivia, S. A. Mr. Miller has spent several years with the Chile Copper Company of Chuquicamata, Chile.

GEORGE C. AVERILL, for the past 17 years identified with the Keyes Fibre Co., Waterville, Me., has retired, following the acquisition of his company by the Rex Pulp Products Co.

E. O. KRAEMER has joined E. I. duPont deNemours and Co., at Wilmington, Del., where he will organize a research bureau in colloid chemistry for that organization.

H. D. FOSTER, heretofore connected with the Bureau of Standards, Washington, D. C., has resigned to become associated with the Ohio Ceramic Industries Association, with headquarters at Columbus.

WILLIAM O'NEILL, president of the General Tire & Rubber Co., Akron, Ohio, has sailed for a trip abroad to study the rubber situation in foreign countries. He will be absent several weeks.

WALTER SENNHAUSER has joined the International Combustion Engineering Corporation, New York, to act as chief engineer for its recently formed subsidiary, the Dry Quenching Equipment Corp., which will develop a system of dry-quenching coke. Mr. Sennhauser heretofore has been engineer for Sulzer Brothers, Winterthur, Switzerland, manufacturers of kindred apparatus.

GEORGE ST. J. PERROTT, who has been at the North Dakota experiment station of the Bureau of Mines is now superintendent of the Pittsburgh, Pa., experiment station of the Bureau, succeeding A. C. Fieldner, who was recently promoted to chief engineer of the division of experiment stations.

J. A. SINGMASTER has accepted a position with the Krebs Pigment & Chemical Co., New York, with factory at Newport, Del., to engage in lithopone development work. F. G. Breyer has joined the company in like capacity.

JOHN B. MADDOCK of Trenton, N. J., has been placed in charge of the clay properties and development at Cornwall, England, of the Paper Makers Importing Co., Easton, Pa.

WALTER C. CARROLL has resigned as vice-president of the Inland Steel Co., Chicago, Ill., in charge of steel sheets, to become president of the American Sheet & Tin Plate Manufacturers' Association, Pittsburgh, Pa.

R. B. HARKNESS of the Department of Mines, Ontario, has been placed in charge of an investigation of china clay deposits on the Metagami River in Ontario Province, with a view to determining the commercial value of the material.

EDWARD L. HARCOURT of the Ohio State University Engineering Experiment Station, Columbus, is now engaged in research work at the brick and clay products plant of the Ohio State Prison, Roseville, O.

E. V. ROMAINE has been placed in charge of a technical division recently established by the General Naval Stores Co., Inc., at Cincinnati, Ohio, and will

engage in special research in perfecting uses for wood rosin.

MARTIN JOSEPH CONNOLLY, chief consulting engineer for E. I. duPont deNemours and Co., Wilmington, Del., has been awarded the honorary degree LL.D., by the Boston College, from which he graduated in '03. Dr. Connolly is a pioneer in the field of celluloid chemistry and an expert in the development of rayon and its commercial possibilities.

A. H. KUECHLER, formerly at the Missouri Engineering Experiment Station, Rollo, is now engaged in research at the physical laboratory of the United Gas Improvement Contracting Co., Philadelphia, Pa.

T. P. WALKER, vice-president of the Commercial Solvents Corp., New York, has been appointed executive vice-president in charge of all activities of the company. Henry H. Berry, heretofore vice-president in charge of the Terre Haute, Ind., plant of the company, has been advanced to vice-president in charge of plants at other points, and will be succeeded at Terre Haute by Charles L. Gabriel.

PAUL TEETOR, formerly with the Trenton Potteries Co. is now director of research at the plant of Thomas Maddock's Sons Co., Trenton, N. J.

FRANK L. SEVENOAK has been appointed acting president of Stevens University, Hoboken, N. J., succeeding Dr. Alexander Humphries, who died Aug. 14.

GEORGE H. PRINGLE has accepted an appointment as engineer with the Mead Pulp and Paper Co., Chillicothe, Ohio.

HAROLD E. WHITE, ceramic engineer who has been with the Federal Abrasives Co., Anniston, Ala., is now a member of the staff of the Lava Crucible Co., Pittsburgh, Pa.

HAROLD V. HUBER, chief chemist for the Nitro Mfg. Co., Pittsburgh, Pa., has been placed in charge of the laboratories and the plant of the company. Thomas M. Felton, recently instructor in the Department of Ceramic Engineering, Ohio State University, Columbus, will be in charge of the production of enamels, glass colors, etc., at the plant.

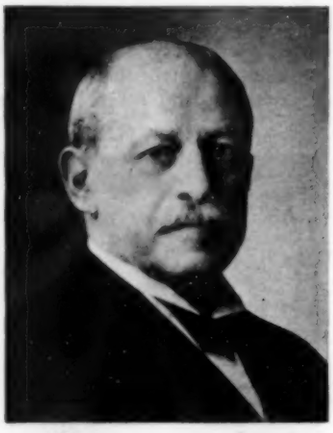
ALWIN MITTASCH, chief chemist of the German dye trust, with laboratories at Oppau bei Ludwigshafen, will soon arrive at New York for a tour of inspection in different parts of the country. Dr. Mittasch is co-inventor of synthetic methanol and coal hydrogenation developments.

HERBERT G. SIDEBOTTOM, formerly of The Barrett Co. and later of Jayne & Sidebottom, Inc., has been appointed assistant to the president of the Darco Sales Corporation. He will also act as assistant to the same executive in his capacity of vice-president and general manager of the L. Martin Co.

WILLIAM H. MAXWELL, JR., formerly representing a group of industrial and business publications, including McGraw-Hill publications, on financial advertising has discontinued this work and has become associated with Hallgarten & Company of New York City.

OBITUARY

CAESAR AUGUSTIN GRASSELLI, chairman of the board of the Grasselli Chemical Company and one of the leading American chemical manufacturers died in Cleveland on July 28, 1927, at the age of 76. For more than thirty years Mr. Grasselli served as president of the Grasselli Chemical Company and under his leadership developed that organization to a leading position among producers of acids and heavy chemicals. He extended the firm's operations to the production of zinc in 1902, making



CAESAR AUGUSTIN GRASSELLI

it in time the second largest American producer of that metal.

He was a man of great vitality and continued active in the affairs of the company even after he handed over the presidency to his son Thomas S. Grasselli in 1916.

The name of Grasselli, like that of the contemporary duPont, has been associated with the chemical industry for more than a century. C. A. Grasselli's grandfather, Jean Ange Grasselli was one of the founders of the European chemical industry and first brought Sicilian brimstone into the Rhineland to make sulphuric acid. At that time E. I. duPont de Nemours was making gunpowder for the soldiers of Louis XVI. One of Grasselli's sons, Eugene Ramiro, founded the American business when he came to Cincinnati in 1839 where Caesar Augustin was born in 1850, the fifth of eight children. He was sixteen when his father moved the business to Cleveland during the great Ohio oil boom of that day. Under his administration the business was changed from a partnership to a corporation and developed from an original capitalization of $600,000 in 1885 to one exceeding $30,000,000 today with plants scattered over the Eastern part of the United States.

ALEXANDER CROMBIE HUMPHREYS, who retired as president of Stevens Institute of Technology after twenty-five years' service died August 14 at Morristown, N. J. He was a gas engineer and had been chief executive of fifty gas and electric companies. He was 76 years of ago.

CALENDAR

AMERICAN CHEMICAL SOCIETY, Detroit, Mich., Sept. 5 to 10.

AMERICAN ELECTROCHEMICAL SOCIETY, Northwestern trip, visiting industrial plants at Minneapolis, Butte, Anaconda, Wallace, Kellogg, Spokane, Seattle, Vancouver, Great Falls, Omaha and Keokuk, Sept. 4-20.

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS, St. Louis, Mo., Dec. 5-8.

AMERICAN REFRACTORIES INSTITUTE, fall meeting, Niagara Falls, Canada, Sept. 15.

AMERICAN SOCIETY FOR STEEL TREATING (ninth annual convention and exposition), Detroit, Sept. 19-24.

AMERICAN WELDING SOCIETY, Detroit, week of Sept. 19.

INSTITUTE OF METALS DIVISION OF THE A.I.M.E., Detroit, Sept. 20, 21 and 22.

NATIONAL EXPOSITION OF CHEMICAL INDUSTRIES, (11th) Grand Central Palace, New York, Sept. 26-Oct. 1.

NATIONAL SYMPOSIUM OF GENERAL ORGANIC CHEMISTRY (second) Ohio State University, Columbus, Ohio, Dec. 29-31.

INDUSTRIAL NOTES

THE AMERICAN ROLLING MILL CO. has acquired the property, plants, business and patents of the Columbia Steel Co. and the Forged Steel Wheel Company at Butler, Pa. and Elyria, Ohio. These properties add another complete manufacturing unit, from pig iron through to finished product, to Armco's producing forces. The Forged Steel Wheel Co. has a capacity of 10,000 tons per month of forged steel wheels. The Columbia Steel Co. has worked out at Butler, Pa., a continuous strip mill to produce sheets in strip form (Stripsheets) up to 36-in. in width. They employ a hot and a cold rolled process in their plan of manufacture. The Columbia Steel Co. will, for a period as yet undetermined, be operated as a separate company, but the entire product will be sold by Armco.

YARNALL-WARING CO., Philadelphia, has opened an office at 314 Wright Building, Tulsa, Okla., in charge of Caleb L. Horne.

THE UDYLITE COMPANY of Kokomo, Ind., has been purchased by Fred J. Fisher of Detroit and the Union Carbide and Carbon Corp. of New York. The purchase included all patents and patent applications owned by the Udylite Co. Sales and general offices for the company will be at 3220 Bellevue Ave., Detroit, headquarters of the General Chromium Corp. M. E. Louth will be general manager of both enterprises.

THE GRAVER CORP., East Chicago, Ind., has appointed Robbins & Robbins, 801 Tschoupitoulas Street, New Orleans, La., sales representatives in the states of Louisiana and Mississippi.

THE NIAGARA BLOWER CO. announces that Claude A. Bulkeley is associated with it as chief engineer.

THE BLAW-KNOX COMPANY, with general offices at Pittsburgh, Pa., has purchased the Milliken Brothers Manufacturing Co. of New York. The consolidation will become effective September 1.

THE POWER SPECIALTY COMPANY and the WHEELER CONDENSER AND ENGINEERING CO. have consolidated and will be known as the Foster Wheeler Corporation. No change in management will be made. The new officers are J. J. Brown, chairman of the board; Pell W. Foster, vice-chairman and treasurer; L. B. Nutting, president; John Primrose, H. S. Brown and W. E. Dowd, Jr., vice-presidents; David McCulloch, secretary and general manager and W. F. Keenan, Jr., chief engineer.

THE OLIVER CONTINUOUS FILTER CO., New York, has obtained larger quarters for its storehouse and laboratory at 445-457 West 31st St., New York City.

MARKET CONDITIONS *and* PRICE TRENDS

Coke and By-Product Activities Are On Steady Basis

DESPITE DISTINCT recession in steel-plant activity the production of by-product coke and gas, tar, crude light oil, and ammonium sulphate as by-products has continued during the first half of 1927 at substantially the average rate maintained during 1926. For the first six months of the year the decrease in rate of production of these commodities below the 1926 average was less than one per cent.

During the first six months of 1927 the estimated activity of the by-product oven industry, based upon U. S. Bureau of Mines reports, was as follows:

Bituminous coal used	31,768,000 net tons
By-product coke made	22,111,000 net tons
Oven gas made (total, including heating gas)	350 billion cu.ft.
Tar produced	270,000,000 gal.
Ammonium sulphate equivalent to liquor and sulphate	350,000 tons
Crude light oil produced	81,000,000 gal.

From the following two tables, indicating in further detail coal consumption and coke production, it is evident that the curtailment in coke supply which corresponds with the curtailment in steel-plant activity has been almost altogether accomplished by the reduction in beehive-oven activity.

MONTHLY OUTPUT OF BY-PRODUCT AND BEEHIVE COKE IN THE UNITED STATES

Net tons. Excludes screenings and breeze.

	By-product Coke	Beehive Coke	Total
January	3,700,000	787,000	4,487,000
February	3,435,000	754,000	4,189,000
March	3,879,000	890,000	4,769,000
April	3,707,000	780,000	4,487,000
May	3,792,000	630,000	4,422,000
June	3,598,000	577,000	4,175,000
Total	22,111,000	4,418,000	26,529,000
1927 monthly ave.	3,685,000	736,000	4,421,000
1924 monthly ave.	2,833,000	806,000	3,639,000
1925 monthly ave.	3,326,000	946,000	4,272,000
1926 monthly ave.	3,712,000	957,000	4,669,000

ESTIMATED MONTHLY CONSUMPTION OF COAL IN THE MANUFACTURE OF COKE

	Consumed in By-product Ovens	Consumed in Beehive Ovens	Total Coal Consumed
January	5,316,000	1,241,000	6,557,000
February	4,935,000	1,189,000	6,124,000
March	5,573,000	1,404,000	6,977,000
April	5,327,000	1,230,000	6,557,000
May	5,448,000	994,000	6,442,000
June	5,169,000	910,000	6,079,000
Total	31,768,000	6,968,000	38,736,000
1927 monthly ave.	5,295,000	1,161,000	6,456,000
1924 monthly ave.	4,060,000	1,272,000	5,332,000
1925 monthly ave.	4,759,000	1,452,000	6,211,000
1926 monthly ave.	5,334,000	1,509,000	6,843,000

DATA on production of various products in the gas industry are not available for current months but the census figures for 1925 have just been announced. The figures show that the establishments engaged primarily in the manufacture of gas for heating and lighting (including Pintsch gas plants) rentals and sales of lamps and appliances to the value of $28,610,845 were reported, making an aggregate value of products amounting to $455,460,053, an increase of 1.2 per cent as compared with $450,097,161 for 1923.

> Normal supply of coal-tar and derivatives is indicated by operations of by-product coke ovens during the first half of the present year.

The total output of gas for sale in 1925 was made up as follows: Coal gas, 7,410,772 M cubic feet, valued at $12,481,294; carbureted water gas, 112,186,108 M cubic feet, $136,624,255; mixed coal and water gas, 210,742,778 M cubic feet, $213,918,207; other mixed gas, 4,773,655 M cubic feet, $3,904,415; and oil gas, 24,288,536 M cubic feet, $29,040,331.

In 1923 the industry was represented by 939 establishments, the decrease to 919 in 1925 being the net result of a gain of 25 and a loss of 45 establishments. The loss is accounted for as follows: Out of business, 12 (including 5 Pintsch gas plants); consolidated with other plants, 7; distributing gas purchased from others, 26.

The following table shows gas and by-product production in 1923 and 1925.

Products, by Kind, Quantity, and Value, and Principal Materials, by Kind and Quantity: 1925 and 1923

		1925	1923
Products, Total value		$455,460,053	$450,097,161
Gas			
Total production	M. cu.ft.	395,520,627	386,547,471
For sale	M. cu.ft.	359,401,849	356,553,990
	Value	395,968,502	394,506,469
Coal gas	M. cu.ft.	7,410,772	7,551,005
	Value	$12,481,294	$12,962,567
Carbureted water gas	M. cu.ft.	112,186,108	117,316,548
	Value	$136,624,255	$134,743,617
Mixed coal and water gas	M. cu.ft.	210,742,778	208,237,762
	Value	$213,918,207	$220,961,192
Otner mixed gas	M. cu.ft.	4,773,655	3,709,568
	Value	$3,904,415	$2,849,641
Oil gas	M. cu.ft.	24,288,536	19,739,107
	Value	$29,040,331	$22,898,880
Plant consumption and loss	M. cu.ft.	36,118,778	29,993,481
By-products			
Total for sale	Value	$30,880,706	$31,476,889
Coke, total production	Short tons	4,032,187	3,728,945
For sale	Short tons	2,398,391	2,175,518
	Value	$20,721,381	$21,532,541
Consumed in plant	Short tons	1,633,796	1,554,427
Screenings and breeze, total production	Short tons	475,080	399,119
For sale	Short tons	62,697	88,752
	Value	$169,455	$343,404
Consumed in plant	Short tons	412,383	310,367
Tar, total production	Gal.	179,633,672	167,234,477
For sale	Gal.	125,274,215	108,867,435
	Value	$6,140,784	$5,040,346
Coal-gas tar	Gal.	63,803,091	58,876,615
	Value	$3,546,759	$3,038,983
Water-gas tar	Gal.	61,219,427	49,750,153
	Value	$2,580,743	$1,986,769
Oil-gas tar	Gal.	251,697	240,667
	Value	$13,282	$14,594
Consumed in plant	Gal.	54,359,457	58,367,042
Ammonia products:			
Total ammonia (NH_3) content	Lb.	24,339,955	22,749,956
	Value	$1,816,092	$1,925,580
Reported as Ammonium sulphate	Lb.	13,439,204	8,050,598
	Value	$351,235	$278,158
Ammonia (NH_3)	Lb.	20,980,154	*20,737,307
	Value	$1,464,857	$1,647,422
Crude light oil	Gal.	1,901,864	1,373,964
	Value	$116,534	$110,393
Light oil derivates	Gal.	2,109,847	1,035,976
	Value	$400,712	$234,233
Drip and holder oil	Gal.	4,354,206	3,924,318
	Value	$295,394	$269,018
Napthalene	Lb.	1,350,156	1,452,463
	Value	$35,752	$45,981
All other by-products	Value	$1,184,602	$1,975,393

*Represents the ammonia content of the following: Ammonia liquors 5,039,223 gal., anhydrous ammonia, 182,676 lb. and ammonia reported in terms of NH_3, 14,634,055 lb.

MARKET CONDITIONS *and* PRICE TRENDS

Favorable Outlook for Consumption of Chemicals

ACCORDING TO estimates of car requirements for the third quarter of the year, manufacturing activities in industries which are large consumers of chemicals, is favorable for an enlarged demand for raw materials. In some cases stocks of materials and finished products are larger than they were a year ago but accumulations do not appear to be large enough to have any deterring effect on production. Basic conditions in many industries are highly satisfactory and in some instances, notably in the leather trade, conditions are more favorable than for many years. Branches of the textile trade are finding more receptive outlets for their products and plans for enlarging the output of rayon have recently been announced by different producers.

CONTRACT DELIVERIES of some of the more important chemicals were reported to have been unusually heavy throughout the last month. As these products have wide application in various branches of the chemical industry, it is deduced that production of chemicals, generally considered, was larger in July than was the case in the corresponding period of last year.

Sales of fertilizer, also, registered a gain in July as compared with the total for July, 1926, but as demand in that month is not heavy the comparison is of lessened significance. For the 12-month period ended July, sales of fertilizer were reported by the National Fertilizer Association as 4,470,000 tons as compared with 5,121,000 tons for the preceding year. It is evident, therefore, that consumption of fertilizer chemicals for the first seven months of 1927 was considerably below that for the corresponding period of 1926. The outlook for fertilizer chemicals has improved materially in recent weeks and the recovery in values for cotton may be expected to increase demand for sulphur, sulphuric acid, potash salts, nitrate of soda, sulphate of ammonia and other chemicals during the remainder of the year.

BASED ON reports to the Department of Commerce

Manufacturing production in June was smaller than in May, after adjustment for working-time differences. As compared with a year ago, however, industrial output was greater. With no adjustments for varying number of days in the month, production of foodstuffs, textiles, lumber, leather, stone and clay products, nonferrous metals and tobacco, showed increases over the preceding month. As compared with a year ago, larger production was registered in foodstuffs, textiles, chemicals and oils, stone and clay products and tobacco, other groups declining. The production of raw material although smaller than in May, was greater than in June, 1926, all groups increasing over a year ago except forest products, which declined.

Stocks of commodities, after adjustments for seasonal variations, showed no change from the previous month, but were higher than in June a year ago. As compared with the previous month, a decline in the stocks of raw materials was sufficient to offset increased holdings in raw foodstuffs, manufactured foodstuffs and other manufactured commodities. As compared with a year ago, all groups showed larger stocks. The unadjusted index of commodity stocks showed an increase over both comparative periods, raw foodstuffs and manufactured foodstuffs showing increases over the previous month, while other raw materials for manufacture and manufactured commodities showed declines from the preceding month. As compared with last year, all groups showed increased stocks.

Unfilled orders for manufactured commodities, principally iron and steel and building materials, showed a decline from both the preceding month and June, 1926, both groups following the general trend.

COMPARISON of indexes of employment prepared by the Bureau of Labor would indicate that production of chemicals was slightly lower in June than in the corresponding month of 1926. Consumption of chemicals, by the same comparison, is shown to have been smaller in the pulp and paper, fertilizer, oil refining, and glass trades and larger in the textile, leather and tire industries. The index of employment for June with comparisons follows:

INDEXES OF EMPLOYMENT

	June 1927	May 1927	June 1926
Dyeing and finishing textiles	97.8	100.3	95.9
Leather	87.5	87.4	86.7
Paper and pulp	92.0	92.2	95.9
Chemicals	94.0	93.2	94.6
Fertilizers	65.6	89.9	74.8
Petroleum refining	96.2	97.6	100.9
Glass	94.9	94.9	100.8
Automobile tires	113.8	116.0	106.8
All manufacturing	89.1	89.7	91.3

Where actual figures are available, comparison of activities reveals variations according to industries. This may be exemplified in the case of chemical wood pulp for which domestic production was lower in June than it was a year ago. The output of explosives also suffers in a comparison of production and consumption for the same months. The output of vegetable oils and fats, on the other hand, was much higher in the quarter ended June 30 this year than it was in the corresponding period last year. The use of coconut oil in manufacture of oleo margarine was more than 20 per cent larger in June than a year ago and for the same periods a similar gain was recorded for cottonseed oil. By-product coke production for the first six months of this year shows very little variation from that for 1926 and the same holds true for resultant products such as tar, ammonia, light oils and pitch.

BECAUSE TRADING in chemicals where large tonnage is involved, has come largely to a basis of long term contracts, prices for these chemicals are not subject to frequent variations, there has been no decided trend to values and fluctuations are found mainly in the less important selections. It is true that improved processes and economies in manufacture have lowered costs of production which had a price bearing on the general industry during the last year but such influences are hardly noticeable in month-to-month comparisons.

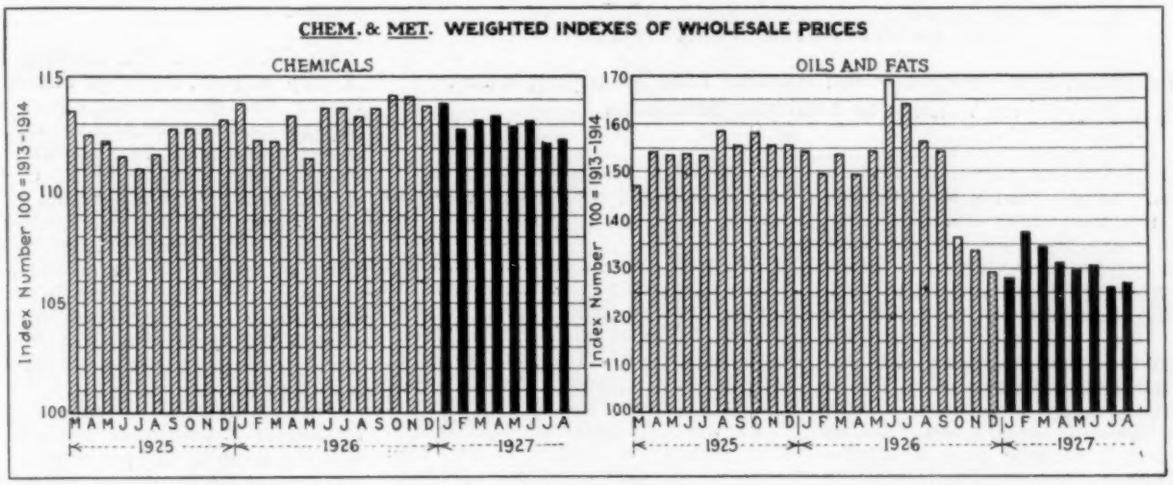
The weighted index number for chemicals and allied products is now reported at 112.35 which compares with 112.23 a month ago, and 113.33 a year ago. The slight advance in the weighted number during the month was brought about by the higher selling schedule for denatured alcohol and by firmer prices for many metal salts which more than balanced declines in values for other chemicals.

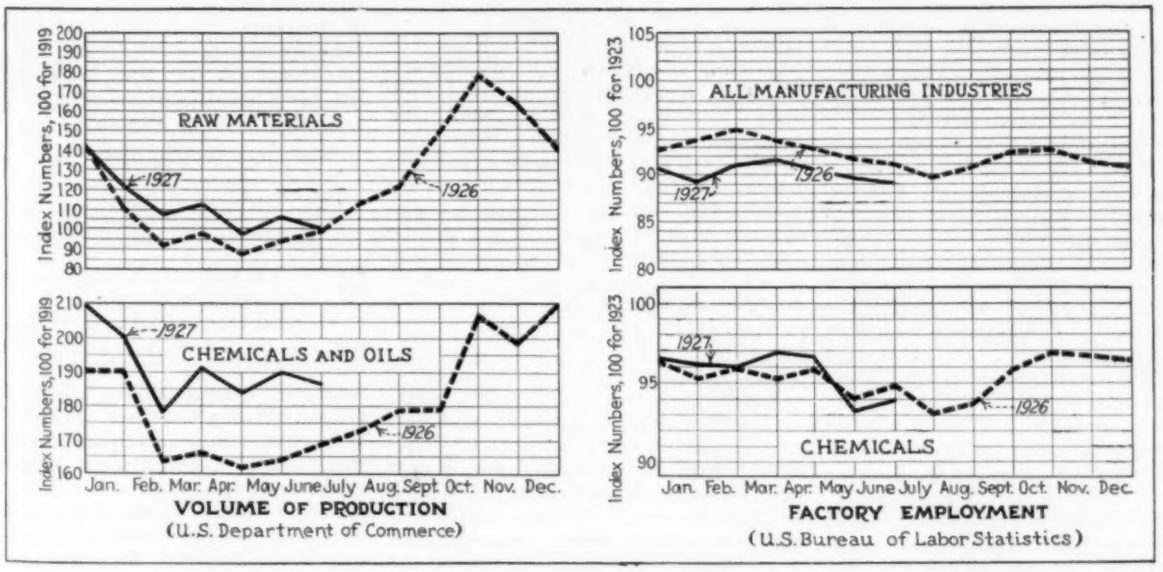
Values for oils and fats, on the other hand, are more or less dependent on conditions surrounding the production of raw materials and price ranges do not necessarily reflect the activities within the producing or consuming industries. The weighted index number for oils and fats now stands at 126.96 which compares with 126.20 a month ago and 156.50 a year ago. The rise during the month came principally from higher prices for crude cottonseed oil although other oils were more firmly held.

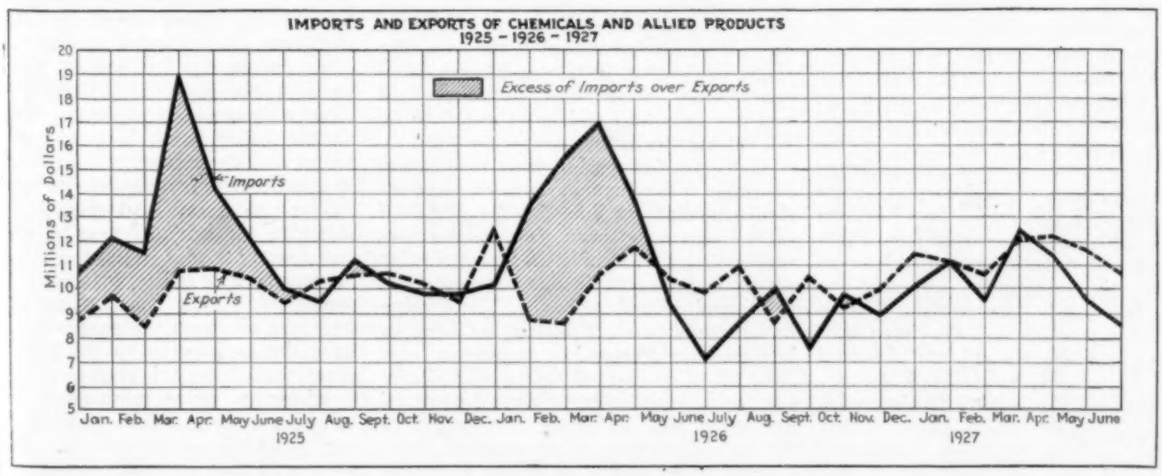
EXPORTS of chemicals and related products in June were valued at $10,695,668 as compared with $9,743,388 in June, 1926. For the 6 months ended June, total value of exports was $68,639,612 as against $59,935,077 for the first half of 1926. These figures prove that a part of the improved call for chemicals this year has come from outside buyers. In the coal-tar group improvement is found in exports of benzol and finished coal-tar products. Acids and anhydrides have found curtailed outlets in foreign markets and the same is true for alcohol. The potassium compounds have fallen off in export trade but marked gains are reported for sodium compounds.

CHEM. & MET. STATISTICS OF BUSINESS

IN THE CHEMICAL ENGINEERING INDUSTRIES


CHEM. & MET. WEIGHTED INDEXES OF WHOLESALE PRICES
CHEMICALS
OILS AND FATS
Index Number 100 = 1913-1914
M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A
1925
1926
1927




IMPORTS AND EXPORTS OF CHEMICALS AND ALLIED PRODUCTS
1925 - 1926 - 1927
Excess of Imports over Exports
Imports
Exports
Millions of Dollars
Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec. Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec. Jan. Feb. Mar. Apr. May June
1925
1926
1927

MARKET CONDITIONS *and* PRICE TRENDS

Imported Chemicals Less Prominent in Domestic Markets

Lessened Competition From Abroad Has Steadying Effect on Values for Different Selections

ONE OF THE important developments in the market for chemicals is found in the smaller arrivals of certain offerings from foreign producing centers. In some instances the falling off in offerings of foreign-made chemicals may be traced to changes in the tariff. For instance the protection afforded by a higher import duty has given domestic producers of nitrite of soda an advantage in securing a large part of domestic orders and this has resulted in a material gain in the domestic output. Scarcity of foreign nitrite of soda has been noted during the last month and while this has not been followed by any upward price revision, it has strengthened belief that home producers have gained control of the market. Oxalic acid has also been in excellent demand with importers offering a minimum of competition as is shown by the relatively high prices quoted for the imported product in comparison with the levels maintained by sellers of domestic. Sales of foreign-made caustic potash have been fairly normal so far this year but the present position of the market would indicate that domestic production has been well absorbed and prices have been firmly maintained. In the case of chlorate of potash, the position is reversed as arrivals from foreign markets have been consistent and price concessions have been given in order to move spot holdings.

THE FIRST reduction in import duty under the flexible provisions of the Tariff act was announced last month. It applied to refined cresylic acid and the reduction was the maximum permissible under the act. The investigation into cresylic acid markets here and abroad included production costs and the new duty was based on an equalization of these costs but the action may be considered somewhat in the nature of securing a supply at a lower cost to consumers. The domestic output of cresylic acid and cresol has not been large enough to fill consuming wants and the lower duty is not looked on as exposing the domestic industry to greatly increased competition. As a matter of fact some of the important producing centers abroad are reported to have no surplus stocks and the announcement of a lowering in duty was met with a higher selling price so that the effects of the modification in customs imposts will not be manifest in the immediate future. Domestic consumption of all grades of cresylic acid in 1925 was estimated at approximately 1,600,000 gal., with imports supplying 965,000 gal.

A HEAVY movement of chemicals for use as insecticides and fungicides has been reported in recent weeks. Copper sulphate has sold in a volume which taxed the capacity of producing plants. The delivery against existing orders practically depleted the spot market and prices were strengthened accordingly. More recently a strong call has been heard for supplies of copper carbonate and an unusually large tonnage is expected to find an outlet this season. Calcium arsenate has been slower in getting into motion but interest has been increasing and prospects for a large distribution have materially improved. Boll weevil emergence was reported some time ago to have been much larger than it was last year and recent reports of weevil damage to the growing cotton plants have stimulated interest in arsenate and an active buying period may be experienced over the remainder of the month. Inquiry for arsenate has been reflected in a firmer market for white arsenic.

ALKALIES have maintained an active position throughout the month. Contract deliveries of caustic soda and soda ash have taken large amounts into consumers hands and compared with a year ago the total tonnage involved is said to have shown an increase. Stocks of bleaching powder either were disposed of or were in firm hands throughout the hot weather period and while prices have been subject to concessions, there has been no general weakness in the market. With the exception of the fertilizer trade, consuming industries have ordered out normal amounts of sulphuric acid and an increased call is expected to be felt during the latter part of the year.

With the figures for June production available it is seen that domestic production of acetate of lime for the first half of the year was lower than in the corresponding period of 1926 and a similar result is apparent in the case of both crude and refined methanol. The decline in methanol production has not been as large as might have been expected from reports of increased offerings of the synthetic product but the influence of the latter may be more pronounced in the immediate future. It is noted, however, that the output of crude methanol has declined but little in comparison with that for refined which is significant of the effects already produced by imports of domestic production of synthetic grades.

PROGRESS OF the growing cotton crop was an object of interest, following the government report which showed conditions as of August 1. This report estimated a final outturn of 13,492,000 bales of cotton. This compares with a yield of 17,977,374 bales in 1926. The current estimate was smaller than had been anticipated and had a bullish effect on prices for cotton and cottonseed oil. The oil market is still influenced by the carry over but if this season's supply of seed is cut down materially, the prospects would favor higher prices for oil.

The condition of the flaxseed crop as of August 1 was more favorable and with condition at 86.4 per cent and yield per acre at 8.8 bu. a total yield of 23,300,000 bu. is in prospect, while this is not sufficient to fill consuming needs of the country it is an improvement on the July report. In the meantime prices for linseed oil have been firmer but this has been based more on current conditions than to crop prospects.

Anti-Freeze Requirements Interest Alcohol Sellers

THERE has been a fairly large contract business in alcohol on the part of the anti-freeze trade, but the greater part of consumers are reported to be uncovered as yet. Hence there is considerable interest among producers of alcohol on the question of how large anti-freeze requirements will be during the present season. Some uncertainty exists relative to the possibility of other materials cutting into consumption of alcohol in that field but trade opinion inclines to the belief that the outlet for alcohol will be up to standards of recent years with variations in weather conditions having some effect on total consumption. The alcohol market has been quiet during the last month, but prices were moved upwards according to previously announced schedules. Methanol, on the other hand, has sold at lower prices and the market is influenced more by competition from sellers of synthetic.

The anti-freeze trade also is of considerable concern to sellers of glycerine and already is said to have exerted some influence on the selling plans of glycerine producers. This has not appeared in the form of direct campaigns for orders from the anti-freeze so much as in reports that imported glycerine has been enjoying a price advantage without bringing out the usual competitive selling from domestic sellers. The inference is that domestic factors are not anxious to push sales at present prices because of the expectation that later

MARKET CONDITIONS *and* PRICE TRENDS

anti-freeze demand will cause a reaction in values which will be in favor of sellers.

European Consumption of Calcium Carbide

THE INTERNATIONAL Acetylene Congress which recently convened at Brussels, Belgium, has issued some interesting statistics showing consumption of calcium carbide in Europe during 1926. Consumption according to the different countries is shown as follows:

	Consumption Tons	Number of Factories
Germany	75,000	10
England	40,000	—
Austria	3,500	3
Belgium	10,000	1
Denmark	2,000	—
Spain	21,000	13
France	80,000	23
Greece	2,000	1
Holland	7,000	—
Italy	27,000	17
Norway	1,500	5
Poland	23,500	4
Rumania	4,000	1
Sweden	3,000	6
Switzerland	4,000	8
Tchechoslowakia	10,000	3

The amount of carbide of calcium consumed in Europe in 1926 was about the same as that consumed in 1913 in the entire world. The European producing capacity surpasses considerably—due to the enormous development during the war—the European consumption.

Keen Competition in Market for Sal Ammoniac

WITH LOWER prices prevailing for ammonia in the last year there has been a logical reason for a lowering in price for sal ammoniac. However, the fact that there has been a tendency to increase domestic production has given an impetus to competitive selling and this undoubtedly has been a factor in establishing current quotations. Competition has been largely confined to domestic factors in opposition to handlers of imported grades. In 1926 imports reached a total of 15,811,876 lb. Domestic production in that year also is reported to have increased in order to take care of the large gain in domestic consumption. Imports for the first half of this year are officially reported at 7,965,447 lb. which, if continued for the second half of the year would mean a total importation in 1927 about equal to that of 1926. In other words imported material appears to be holding its own in the struggle for domestic trade. Contract prices for gray sal ammoniac, however, have been reduced to a point where at present sales are made at the lowest figure on record. Foreign-made material is now carrying a premium, at least in territories where freight rates are not in its favor. Under these conditions it is problematical whether imports will hold up to the average established in the first half of the year.

In the case of white sal ammoniac, competition has not been entirely confined to the imported offerings. It is reported that the enlarged consuming market attracted the attention of prospective producers and in some cases plans were actually carried out to get into production but subsequent lowering in sales prices made the success of such manufacture doubtful especially as further price declines were thought to be forthcoming and as far as can be learned domestic production has been left in the hands of original factors.

Synthetic Dye Imports Still Declining

Returns for import trade in July demonstrate that arrivals of synthetic dyes from foreign countries continue to fall behind, in volume, the totals registered last year. Official figures place July imports at 263,162 lb. as compared with 351,425 lb. in July, 1926. For the first seven months of the year imports compare as follows:

IMPORTS OF SYNTHETIC DYES

	1927 Lb.	1926 Lb.
January	169,620	300,441
February	312,277	369,045
March	404,714	487,804
April	402,783	437,526
May	349,476	392,739
June	318,450	333,319
July	263,162	351,425
Totals	2,247,482	2,672,299

Large Production of Oils and Fats

THE DEPARTMENT of Commerce has announced that the factory production of fats and oils (exclusive of refined oil and derivatives) during the three-month period ended June 30, 1927, was as follows: Vegetable oils, 487,200,695 lb.; fish oils, 7,008,433 lb.; animal fats, 583,333,175 lbs.; and grease, 102,615,614 lb.; a total of 1,180,157,917 lb.

Of the several kinds of fats and oils covered by this inquiry, the statement said, the greatest production, 458,802,328 lb., appears for lard. Next in order is cottonseed oil with 204,802,851 lb.; linseed oil with 167,232,121 lb.; tallow with 122,178,405 lb. coconut oil with 71,931,662 lb.; and corn oil with 27,779,405 lb.

The production of refined oils during the period was announced as follows: Cottonseed 273,120,362 lb.; coconut, 63,838,821 lb.; peanut, 1,485,101 lb.; corn, 18,112,611 lb.; soya-bean, 647,962 lb.; and palm-kernel, 389,730 lb.

Exports of Chemicals

	June 1927	June 1926
Benzol, gal.	2,174,280	544,230
Crude coal-tar and pitch, bbl.	33,546	7,168
Acid, sulphuric, lb.	746,096	453,315
Other acids, lb.	1,226,310	1,236,640
Methanol, gal.	2,201	37,811
Ammonia and compounds, lb.	251,743	332,242
Aluminum sulphate, lb.	3,891,478	4,455,121
Acetate of lime, lb.	562,168	2,234,702
Calcium carbide, lb.	639,151	583,301
Bleaching powder, lb.	2,458,250	2,730,994
Copper sulphate, lb.	401,502	199,238
Formaldehyde, lb.	75,514	124,435
Potassium compounds, lb.	106,492	210,747
Sodium bichromate, lb.	728,670	733,458
Sodium cyanide, lb.	47,310	60,755
Borax, lb.	7,939,893	2,843,020
Soda ash, lb.	4,982,325	4,016,130
Sodium silicate, lb.	4,179,870	3,936,663
Sal soda, lb.	1,039,944	1,037,497
Caustic soda, lb.	6,749,615	8,255,793
Bicarbonate of soda, lb.	1,351,918	1,279,551
Sulphate of ammonia, ton	12,808	19,106
Sulphur, ton	84,071	50,098

Imports of Chemicals

	June 1927	June 1926
Lead or creosote oil gal.	10,231,517	10,306,706
Pyridine, lb.	.....	72,206
Coal-tar acids, lb.	5,986	9,880
Coal-tar intermediates, lb.	173,816	200,878
Arsenic, lb.	2,721,342	3,126,377
Acid, citric, lb.	.....	3,248
Acid, formic, lb.	598,826	121,649
Acid, oxalic, lb.	152,856	122,687
Acid, sulphuric, lb.	1,867,513	5,981,798
Acid, tartaric, lb.	217,781	187,912
Ammonium chloride, lb.	684,943	868,305
Ammonium nitrate, lb.	1,161,643	1,223,779
Barium compounds, lb.	1,609,718	4,402,990
Calcium carbide, lb.	136,400	1,000,510
Cobalt oxide, lb.	33,100	27,000
Copper sulphate, lb.	28,606	111,045
Bleaching powder, lb.	387,344	393,226
Lime citrate, lb.	.....	617,162
Glycerine, crude, lb.	984,468	1,141,926
Glycerine, refined, lb.	861,522	512,826
Magnesium compounds, lb.	1,247,651	2,243,147
Potassium cyanide, lb.	2,328	11,243
Potassium carbonate, lb.	890,325	1,018,972
Potassium nitrate, ton	2,048	20
Caustic potash, lb.	1,099,338	1,301,830
Cream of tartar, lb.	100	39,200
Potassium chlorate, lb.	1,203,497	710,546
Sodium cyanide, lb.	1,833,613	2,166,396
Sodium ferrocyanide, lb.	166,039	44,514
Sodium nitrite, lb.	28,000	135,404
Sodium nitrate, ton	39,683	12,225
Sulphate of ammonia, ton.	1,841	2,546

Chem. & Met. Weighted Index of Chemical Prices

Base = 100 for 1913-14

This month	**112.35**
Last month	112.23
August, 1926	113.33
August, 1925	111.67

Firmer markets ruled for most of the metal salts. In the coal-tar list phenal was advanced in price. Alkalies and mineral acids held a steady position. Consuming demand practically exhausted supplies of copper sulphate.

Chem. & Met. Weighted Index of Prices for Oils and Fats

Base = 100 for 1913-14

This month	**126.97**
Last month	126.20
August, 1926	156.50
August, 1925	158.37

Net changes in the market for oils and fats were in favor of higher average prices. Declines in menhaden and China wood oils being more than offset by the higher position of crude cottonseed, linseed, and miscellaneous oils.

CURRENT PRICES *in the* NEW YORK MARKET

For Chemicals, Oils and Allied Products

The following prices refer to round lots in the New York Market. Where it is the trade custom to sell f.o.b. works, quotations are given on that basis and are so designated. Prices are corrected to August 15.

Industrial Chemicals

	Current Price	Last Month	Last Year
Acetone, drums lb.	$0.12 -$0.13	$0.11½-$0.13	$0.12 -$0.13
Acid, acetic, 28%, bbl cwt.	3.38 - 3.63	3.38 - 3.63	3.25 - 3.50
Boric, bbl lb.	.08½- .08½	.08½- .08½	.08½- .11
Citric, kegs lb.	.44½- .45	.44½- .45	.45 - .47
Formic, bbl lb.	.11 - .12	.10½- .11	.10½- .11
Gallic, tech., bbl lb.	.50 - .55	.50 - .55	.45 - .50
Hydrofluoric 30% carb lb.	.06 - .07	.06 - .07	.06 - .07
Lactic, 44%, tech., light, bbl lb.	.13½- .14	.13½- .14	.13½- .14
22%, tech., light, bbl lb.	.06½- .07	.06½- .07	.06½- .07
Muriatic, 18°, tanks cwt.	.85 - .90	.85 - .90	.85 - .90
Nitric, 36°, carboys cwt.	.05 - .05½	.05 - .05½	.05 - .05½
Oleum, tanks, wks ton	18.00 -20.00	18.00 -20.00	18.00- 20.00
Oxalic, crystals, bbl lb.	.11 - .11½	.11 - .11½	.10½- .11
Phosphoric, tech., c'bys lb.	.07 - .07½	.07 - .07½	.07 - .07½
Sulphuric, 60°, tanks ton	10.50 -11.00	10.50 -11.00	10.50 -11.00
Tannic, tech., bbl lb.	.35 - .40	.35 - .40	.35 - .40
Tartaric, powd., bbl lb.	.37 - .37½	.37 - .37½	.29 - .30
Tungstic, bbl lb.	1.00 - 1.20	1.00 - 1.20	1.00 - 1.20
Alcohol, ethyl, 190 p'f. U.S.P. bbl gal.	3.75 - 4.00	3.75 - 4.00	4.85 - 4.90
Alcohol, Butyl, dr lb.	.19½- .20½	.19½- .20½	.18½- .19
Denatured, 190 proof			
No. 1 special dr gal.	.47½-	.46½	.28 -
No. 5, 188 proof, dr gal.	.45 -	.44	.28 - .32
Alum, ammonia, lump, bbl lb.	.03½- .04	.03½- .04	.03½- .04
Chrome, bbl lb.	.05½- .05½	.05½- .05½	.05½- .06
Potash, lump, bbl lb.	.02½- .03½	.02½- .03½	.02½- .03½
Aluminum sulphate, com., bags cwt.	1.40 - 1.45	1.40 - 1.45	1.40 - 1.45
Iron free, bg cwt.	2.00 - 2.10	2.00 - 2.10	2.40 - 2.45
Aqua ammonia, 26°, drums lb.	.02½- .03	.02½- .03½	.03½- .04
Ammonia, anhydrous, cyl lb.	.11 - .13	.11 - .15	.13 - .15
Ammonium carbonate, powd. tech., casks lb.	.10½- .14	.10½- .14	.11 - .14
Sulphate, wks cwt.	2.25 -	2.25 -	2.50 -
Amylacetate tech., drums gal.	2.15 - 2.20	2.15 - 2.20	1.80 - 1.90
Antimony Oxide, bbl lb.	.16 - .16½	.16 - .17½	.14½- .15
Arsenic, white, powd., bbl lb.	.03½- .04½	.03½- .04½	.03½- .04½
Red, powd., kegs lb.	.09½- .10	.08½- .10	.11 - .12
Barium carbonate, bbl ton	50.00 -52.00	50.00 -52.00	48.00 -50.00
Chloride, bbl ton	58.00 -60.00	58.00 -60.00	63.00 -65.00
Nitrate, casks lb.	.08 - .08½	.07½- .08½	.07½- .08
Blanc fixe, dry, bbl lb.	.04 - .04½	.04 - .04½	.03½- .04
Bleaching powder, f.o.b., wks., drums cwt.	2.00 - 2.10	2.00 - 2.10	2.00 - 2.10
Borax, bbl lb.	.04½- .04½	.04½- .05	.05 - .05½
Bromine, cs lb.	.45 - .47	.45 - .47	.45 - .47
Calcium acetate, bags cwt.	3.50 -	3.50 -	3.25 - 3.50
Arsenate, dr lb.	.07½- .08	.06½- .07	.06 - .07
Carbide drums lb.	.05 - .06	.05½- .06	.05½- .06
Chloride, fused, dr., wks ton	21.00 -	21.00 -	21.00 -
Phosphate, bbl lb.	.07 - .07½	.07 - .07½	.07 - .07½
Carbon bisulphide, drums lb.	.05½- .06	.05½- .06	.05½- .06
Tetrachloride drums lb.	.06½- .07	.06½- .07	.06½- .07
Chlorine, liquid, tanks, wks lb.	.04 - .04½	.04 - .04½	.04 - .04½
Cylinders lb.	.05½- .08	.05½- .08	.05½- .08
Cobalt oxide, cans lb.	2.00 - 2.10	2.00 - 2.10	2.10 - 2.25
Copperas, bgs., f.o.b. wks ton	14.00 -17.00	14.00- 17.00	13.00 -15.00
Copper carbonate, bbl lb.	.17 - .17½	.17 - .18	.16½- .17
Cyanide, tech., bbl lb.	.49 - .50	.49 - .50	.49 - .50
Sulphate, bbl cwt.	4.90 - 5.00	4.80 - 4.90	4.75 - 5.00
Cream of tartar, bbl lb.	.27½- .28	.22 - .22½	.21 - .22
Epsom salt, dom., tech., bbl. cwt.	1.75 - 2.15	1.75 - 2.00	1.75 - 2.00
Imp., tech., bags cwt.	1.15 - 1.25	1.15 - 1.25	1.35 - 1.40
Ethyl acetate, 85% drums gal.	.74 - .76	.74 - .76	.78 - .80
99% dr gal.	.95 - .96	.95 - .96	.98 - 1.04
Formaldehyde, 40%, bbl lb.	.11½- .11½	.11½- .11½	.09 - .09½
Furfural, dr lb.	.15 - .17½	.15 - .17½	.15 - .17
Fusel oil, crude, drums gal.	1.30 - 1.40	1.35 - 1.40	1.40 - 1.50
Refined, dr gal.	2.50 - 3.00	2.50 - 3.00	2.50 - 3.00
Glauber's salt, bags cwt.	1.00 - 1.15	1.00 - 1.10	1.20 - 1.40
Glycerine, e.p., drums, extra lb.	.23 - .24	.24½- .25	.30 -
Lead:			
White, basic carbonate, dry, casks lb.	.09 -	.09 -	.10½-
White, basic sulphate, sck lb.	.08½-	.08½-	.09½-
Red, dry, sck lb.	.10½-	.09½-	.12 -
Lead acetate, white crys., bbl lb.	.13 - .13½	.14½- .15	.14½-
Lead arsenate, powd., bbl lb.	.12 - .13	.14 - .15	.14 - .15
Lime, chem., bulk ton	8.50 -	8.50 -	8.50 -
Litharge, pwd., csk lb.	.09½-	.08½-	.11½-
Lithopone, bags lb.	.05½- .06	.05½- .06	.05½- .06½
Magnesium carb., tech., bags lb.	.07½- .08	.07½- .08	.06 - .06½
Methanol, 95%, dr gal.	.55 -	.68 - .70	.70 - .72
97%, dr gal.	.55 -	.85 - .90	.72 - .74
Nickel salt, double, bbl lb.	.10 - .10½	.10 - .10½	.09 - .10
Single, bbl lb.	.10½- .11	.10½- .11	.10 - .11
Orange mineral, csk lb.	.12½-	.11½-	.14 -
Phosphorus, red, cases lb.	.62 - .65	.62 - .65	.65 - .68
Yellow, cases lb.	.32 - .33	.32 - .34	.33 - .34
Potassium bichromate, casks lb.	.08½- .08½	.08½- .08½	.08½- .08½
Carbonate, 80-85%, calc., csk lb.	.05½- .06	.06 -	.06 - .06½
Chlorate, powd lb.	.08½- .09	.08½- .09	.08½- .09
Cyanide, cs lb.	.55 - .57	.55 - .58	.55 - .57
First sorts, csk lb.	$0.09 -$0.09½	$0.08½-$0.09	$0.08½-$0.09
Hydroxide(c'stic potash) dr lb.	.07½- .07½	.07½- .07½	.07½- .07½
Muriate, 80% bgs ton	36.40 -	36.40 -	34.90 -
Nitrate, bbl lb.	.06 - .06½	.06 - .06½	.06 - .07½
Permanganate, drums lb.	.14 - .15	.14 - .15	.14½- .15
Prussiate, yellow, casks lb.	.18½- .19	.18½- .19	.18½- .19
Sal ammoniac, white, casks lb.	.05½- .06	.05½- .06½	.05½- .06
Salsoda, bbl cwt.	.90 - .95	.90 - .95	.06½- .06½
Salt cake, bulk ton	17.00 -18.00	17.00 -18.00	17.00 -19.00
Soda ash, light, 58%, bags, contract cwt.	1.32½-	1.32½-	1.38 -
Dense, bags cwt.	1.37½-	1.37½- 1.55	1.45 - 1.55
Soda, caustic, 76%, solid, drums, contract cwt.	3.00 -	3.00 -	3.10 -
Acetate, works, bbl lb.	.04½- .05½	.04½- .05	.04½- .05
Bicarbonate, bbl cwt.	2.00 - 2.25	2.00 - 2.25	2.00 - 2.25
Bichromate, casks lb.	.06½- .06½	.06½- .06½	.06½- .06½
Bisulphate, bulk ton	5.00 - 5.50	5.00 - 5.50	6.00 - 7.00
Bisulphite, bbl lb.	.03½- .04	.03½- .04	.03½- .04
Chlorate, kegs lb.	.06½- .06½	.06½- .06½	.06½- .06½
Chloride, tech ton	12.00 -14.75	12.00- 14.75	12.00 -14.00
Cyanide, cases, dom lb.	.18 - .22	.18 - .22	.19 - .22
Fluoride, bbl lb.	.08½- .09	.09½- .10	.08½- .09
Hyposulphite, bbl lb.	2.50 - 3.00	2.50 - 3.00	2.65 - 3.00
Nitrate, bags cwt.	2.50 -	2.50 -	2.34 -
Nitrite, casks lb.	.08½- .08½	.08 - .08½	.08½- .09
Phosphate, dibasic, bbl lb.	.03½- .03½	.03½- .03½	.03½- .03½
Prussiate, yel. drums lb.	.12 - .12½	.12 - .12½	.10½- .10½
Silicate (30°, drums) cwt.	.75 - 1.15	.75 - 1.15	.75 - 1.15
Sulphide, fused, 60-62%, dr lb.	.03½- .04	.03 - .03½	.02½- .03
Sulphite, crys., bbl lb.	.03 - .03½	.03 - .03½	.02½- .03
Strontium nitrate, bbl lb.	.08½- .09	.08½- .09	.08½- .09
Sulphur, crude at mine, bulk ton	19.00 -	19.00 -	19.00 -20.00
Chloride, dr lb.	.04 - .05	.04 - .05	.05 - .05½
Dioxide, cyl lb.	.09 - .10	.09 - .10	.09 - .10
Flour, bag cwt.	2.70 - 3.00	2.70 - 3.00	2.70 - 3.00
Tin bichloride, bbl lb.	.18½-	.19½-	.18½-
Oxide, bbl lb.	.67 -	.69 -	.66 -
Crystals, bbl lb.	.45 -	.47 -	.43 -
Zinc chloride, gran., bbl lb.	.06½- .06½	.06½- .06½	.07 - .07½
Carbonate, bbl lb.	.10 - .11	.10 - .10½	.10½- .11
Cyanide, dr lb.	.40 - .41	.40 - .41	.40 - .41
Dust, bbl lb.	.10½- .11	.10½- .11	.09 - .10
Zinc oxide, lead free, bag lb.	.06½-	.06½-	.07½-
5% lead sulphate, bags lb.	.06½-	.06½-	.07½-
Sulphate, bbl cwt.	2.75 - 3.00	2.75 - 3.00	2.75 - 3.00

Oils and Fats

	Current Price	Last Month	Last Year
Castor oil, No. 3, bbl lb.	$0.12½-$0.13	$0.13½-$0.14½	$0.12½-$0.13
Chinawood oil, bbl lb.	.17 -	.19 -	.12½- .13
Coconut oil, Ceylon, tanks, N. Y. lb.	.08½-	.08½-	.10 -
Corn oil crude, tanks, (f.o.b. mill) lb.	.11 -	.11 -	.12 -
Cottonseed oil, crude (f.o.b. mill), tanks lb.	.08½-	.08½-	.14 -
Linseed oil, raw, car lots, bbl lb.	10.8 -	10.6 -	12.3 -
Palm, Lagos, casks lb.	.07½-	.07½- .08	.09 -
Niger, casks lb.	.07½-	.07½- .07½	.08½-
Palm Kernel, bbl lb.	.08½-	.08½-	.10½-
Peanut oil, crude, tanks(mill) lb.	.12½-	.12½-	.12 -
Perilla, bbl lb.	-	-	-
Rapeseed oil, refined, bbl gal.	.78 - .80	.78 - .80	.89 - 91
Sesame, bbl lb.	-	-	-
Soya bean tank (f.o.b. Coast) lb.	.09½-	.09½-	.10½-
Sulphur(olive foots), bbl lb.	.08½-	.08½-	.08½-
Cod, Newfoundland, bbl gal.	.63 - .62	.63 - .64	.60 - .65
Menhaden, light pressed, bbl gal.	.60 - .66	.60 - .62	.65 - .68
Crude, tanks(f.o.b. factory) gal.	.41 -	.45 -	.47½-
Whale, crude, tanks lb.	-	-	-
Grease, yellow, loose lb.	.06½-	.06½-	.08½-
Oleo stearine lb.	.00½-	.10½-	.12½-
Red oil, distilled, d.p. bbl lb.	.09½- .09½	.09½- .10	.10 - .10½
Tallow, extra, loose lb.	.07½-	.07½-	.08½-

Coal-Tar Products

	Current Price	Last Month	Last Year
Alpha-naphthol, crude, bbl lb.	$0.60 -$0.65	$0.60 -$0.65	$0.60 -$0.62
Refined, bbl lb.	.85 - .90	.85 - .90	.85 - .90
Alpha-naphthylamine, bbl lb.	.35 - .36	.35 - .36	.35 - .36
Aniline oil, drums, extra lb.	.15 - .16	.15 - .16	.16 - .16½
Aniline salts, bbl lb.	.24 - .25	.24 - .25	.22 - .23
Anthracene, 80%, drums lb.	.60 - .65	.60 - .65	.60 - .65

Coal Tar Products (Continued)

		Current Price	Last Month	Last Year
Benzaldehyde, U.S.P., dr.	lb.	$1.15 -$1.25	$1.15 -$1.35	$1.30 -$1.35
Benzidine base, bbl.	lb.	.70 - .72	.70 - .75	.72 - .74
Benzoic acid, U.S.P., kgs.	lb.	.58 - .60	.58 - .60	.56 - .60
Benzyl chloride, tech, dr.	lb.	.25 - .26	.25 - .26	.25 - .26
Benzol, 90%, tanks, works	gal.	.24 - .25	.24 - .25	.25 - .26
Beta-naphthol, tech., drums	lb.	.22 - .24	.22 - .24	.22 - .24
Cresol, U.S.P., dr.	lb.	.18 - .20	.18 - .20	.18 - .20
Cresylic acid, 97%, dr., wks.	gal.	.61 - .62	.61 - .62	.60 - .65
Diethylaniline, dr.	lb.	.58 - .60	.58 - .60	.58 - .60
Dinitrophenol, bbl.	lb.	.31 - .35	.31 - .33	.31 - .35
Dinitrotoluen, bbl.	lb.	.17 - .18	.17 - .18	.18 - .20
Dip oil, 25% dr.	gal.	.28 - .30	.28 - .30	.28 - .30
Diphenylamine, bbl.	lb.	.45 - .47	.45 - .47	.48 - .50
H-acid, bbl.	lb.	.63 - .65	.63 - .65	.65 - .66
Naphthalene, flake, bbl.	lb.	.04½- .05	.05½- .06	.06½- .07
Nitrobensene, dr.	lb.	.09 - .10	.09 - .10	.09 - .10
Para-nitraniline, bbl.	lb.	.52 - .53	.45 - .50	.50 - .53
Para-nitrotoluine, bbl.	lb.	.28 - .32	.28 - .32½	.40 - .42
Phenol, U.S.P., drums	lb.	.18 - .19	.17 - .19	.22 - .24
Picric acid, bbl.	lb.	.30 - .40	.30 - .40	.25 - .26
Pyridine, dr.	lb.	3.00 -.....	3.00 -.....	3.90 - 4.00
R-salt, bbl.	lb.	.47 - .50	.40 - .44	.50 - .55
Resorcinal, tech, kegs.	lb.	1.30 - 1.35	1.35 - 1.40	1.30 - 1.40
Salicylic acid, tech., bbl.	lb.	.30 - .32	.30 - .32	.32 - .33
Solvent naphtha, w.w., tanks	gal.	.35 -.....	.35 -.....	.35 -.....
Tolidine, bbl.	lb.	.95 - .95	.95 - .96	.90 - .95
Toluene, tanks, works	gal.	.35 -.....	.35 -.....	.35 -.....
Xylene, com., tanks	gal.	.36 - .41	.36 - .41	.36 - .40

Miscellaneous

		Current Price	Last Month	Last Year
Barytes, grd., white, bbl.	ton	$23.00-$25.00	$23.00-$25.00	$23.00-$25.00
Casein, tech., bbl.	lb.	.17 - .18	.17½- .18	.17½- .18
China clay, dom., f.o.b. mine	ton	10.00 -20.00	10.00 -20.00	10.00 -20.00
Dry colors:				
Carbon gas, black (wks.)	lb.	.06½- .07	.06½- .07	.08 - .08½
Prussian blue, bbl.	lb.	.33 - .34	.33 - .34	.32 - .33
Ultramine blue, bbl.	lb.	.08 - .35	.08 - .35	.08 - .35
Chrome green, bbl.	lb.	.27 - .31	.28 - .30	.28 - .30
Carmine red, tins	lb.	5.50 - 5.75	5.00 - 5.10	5.10 - 5.85
Para toner	lb.	.80 - .90	.80 - .90	.90 - .95
Vermilion, English, bbl.	lb.	1.80 - 1.85	1.80 - 1.85	1.45 - 1.50
Chrome yellow, C. P., bbl.	lb.	.17 - .18	.17½- .18	.17½- .18
Feldspar, No. 1 (f.o.b. N. C.)	ton	5.75 - 7.00	6.50 - 7.00	6.00 - 6.50
Graphite, Ceylon, lump, bbl.	lb.	.07½- .08	.07 - .09½	.09 - .10
Gum copal, Congo, bags	lb.	.09½- .10	.09½- .10	.09½- .10
Manila, bags	lb.	.15 - .18	.15 - .16	.14 - .10
Damar, Batavia, cases	lb.	.25 - .25½	.25 - .26	.25 - .25
Kauri, No. 1 cases	lb.	.55 - .57	.55 - .57	.58 - .62
Kieselguhr (f.o.b. N. Y.)	ton	50.00 -55.00	50.00 -55.00	50.00 -55.00
Magnesite, calc.	ton	44.00 -.....	44.00 -.....	38.00 -42.00
Pumice stone, lump, bbl.	lb.	.05 - .07	.05 - .08	.04½- .06
Imported, casks	lb.	.03 - .40	.03 - .40	.03 - .35
Rosin, H.	bbl.	10.90 -.....	10.00 -.....	15.40 -.....
Turpentine	gal.	.61 -.....	.57 -.....	.94 -.....
Shellac, orange, fine, bags	lb.	.60 - .61	.52 - .53	.36 - .38
Bleached, bonedry, bags	lb.	.67 - .69	.59 - .61	.38 - .40
T. N. bags	lb.	.58 - .59	.42 - .44	.27 - .29
Soapstone (f.o.b. Vt.), bags	ton	10.00 -12.00	10.00 -12.00	9.00 -11.00
Talc, 200 mesh (f.o.b. Vt.)	ton	10.50 -.....	11.00 -.....	10.50 -.....
200 mesh (f.o.b. Ga.)	ton	7.50 -10.00	7.50 -10.00	7.50 -11.00
325 mesh (f.o.b. N. Y.)	ton	13.75 -.....	14.75 -.....	14.75 -.....

		Current Price	Last Month	Last Year
Wax, Bayberry, bbl.	lb.	$0.23 -$0.26	$0.25 -$0.26	$0.20 -$0.21
Beeswax, ref., light	lb.	.43 - .45	.45 - .47	.46 - .47
Candelilla, bags	lb.	.38 - .39	.34 - .35	.36 - .37
Carnauba, No. 1, bags	lb.	.57 - .60	.70 - .72	.48 - .50
Paraffine, crude 105-110 m.p.	lb	.05½- .06	.06 - .06½	.05½- .06

Ferro-Alloys

		Current Price	Last Month	Last Year
Ferrotitanium, 15-18%	ton	$200.00-.....	$200.00-.....	$200.00-.....
Ferrochromium, 1-2%	lb.	.23- .25	.23- .35	.23-.....
Ferromanganese, 78-82%	ton	90.00-.....	88.00-90.00	88.00-90.00
Spiegeleisen, 19-21%	ton	33.00-35.00	36.00-37.00	33.00-34.00
Ferrosilicon, 10-12%	ton	33.00-38.00	33.00-38.00	33.00-38.00
Ferrotungsten, 70-80%	lb.	.95- 1.00	1.00- 1.05	1.05- 1.10
Ferro-uranium, 35-50%	lb.	4.50-.....	4.50-.....	4.50-.....
Ferrovanadium, 30-40%	lb.	3.15- 3.75	3.25- 4.00	3.25- 3.75

Non-Ferrous Metals

		Current Price	Last Month	Last Year
Copper, electrolytic	lb.	$0.13 31-.....	$0.12½-.....	$0.14½-.....
Aluminum, 96-99%	lb.	.26 -$0.28	.26 -$0.27	.27 -$0.28
Antimony, Chin. and Jap.	lb.	.12 - .12½	.12 - .12½	.15½- .16
Nickel, 99%	lb.	.35 -.....	.35 -.....	.35 -.....
Monel metal, blocks	lb.	.32 - .33	.32 - .33	.32 - .33
Tin, 5-ton lots, Straits	lb.	.64½-.....	.67½-.....	.64½-.....
Lead, New York, spot	lb.	6.75 -.....	6.20 -.....	8.40 -.....
Zinc, New York, spot	lb.	6.70 -.....	6.57 -.....	7.65 -.....
Silver, commercial	oz.	.57½-	.57½-	.63½-.....
Cadmium	lb.	.60 -.....	.60 -.....	.60 -.....
Bismuth, ton lots	lb.	2.20 - 2.25	2.20 - 2.25	2.70 - 2.75
Cobalt	lb.	2.50 -.....	2.50 -.....	3.00
Magnesium, ingots, 99%	lb.	.75 - .80	.75 - .80	.75 - .80
Platinum, ref.	oz.	86.00-	86.00-	111.00-
Palladium, ref.	oz.	59.00- 63.00	59.00- 63.00	69.00-71.00
Mercury, flask	75 lb.	121.00-.....	117.00-	99.50-.....
Tungsten powder	lb.	1.05- 1.15	1.05-.....	1.10-.....

Ores and Semi-finished Products

		Current Price	Last Month	Last Year
Bauxite, crushed, wks.	ton	$5.50- $8.50	$5.50- $8.50	$5.50- $8.75
Chrome ore, c.f. post	ton	22.00- 24.00	21.00- 24.00	22.00- 23.00
Coke, fdry., f.o.b. ovens	ton	3.75- 4.25	3.75- 4.25	3.75- 4.25
Fluorspar, gravel, f.o.b. Ill.	ton	17.00- 18.00	18.00-.....	18.00-.....
Ilmenite, 52% TiO_2, Va.	lb.	.0¾- .0¾	.0¾ - .0¾	.01½-.....
Manganese ore, 50% Mn., c.i.f. Atlantic Ports	unit	.36 - .38	.36 - .38	.40 - 42
Molybdenite, 85% MoS_2 per lb. MoS_2, N. Y.	lb.	.48 - .50	.48 - .50	65- .70
Monazite, 6% of ThO_2	ton	120.00-.....	120.00-.....	120.00-.....
Pyrites, Span. fines, c.i.f.	unit	.13½-.....	.13½-.....	.13½-.....
Rutile, 94-96% TiO_2	lb.	.11 - .13	.11 - .13	.12 - .15
Tungsten, scheelite, 60% WO_3 and over	unit	11.25 -11.50	11.25 -11.50	12.50 -13.00
Vanadium ore, per lb. V_2O_5	lb.	.25 - .28	.25 - .30	30 - .35
Zircon, 99%	lb.	.03 -.....	.03 -.....	.03 -.....

CURRENT INDUSTRIAL DEVELOPMENTS

New Construction and Machinery Requirements

Aluminum Plant—Leyse Aluminum Co., A. Leyse, Mgr., Kewaunee, Wis., is having plans prepared for the construction of a 2 story, 56 x 97 ft. aluminum plant. Estimated cost $40,000. Private plans.

Battery (Lead) Factory—National Lead Battery Co., 1728 Roblyn Ave., St. Paul, Minn., awarded contract for the construction of a 2 story lead battery factory at 39th St., North Bergen, N. J. to Bonnanno Bros., 998 Bergenline Ave., Union City, N. J. Estimated cost $150,000.

Benzol Plant — Hamilton By-Products Coke Co., Hamilton, Ont., awarded contract for the construction of a benzol plant to Semmet Solvay Co., 40 Rector St., New York, N. Y. Estimated cost $500,000.

Brass Foundry Addition—Chaplin Fulton Mfg. Co., 28 Pennsylvania Ave., Pittsburgh, Pa., is having plans prepared for the construction of a 3 story, 32 x 110 ft. brass foundry. Estimated cost $100,000. B. H. Prack, Martin Bldg., Pittsburgh, Pa., is architect.

Brass Foundry Addition—Messmer Brass Co., 2700 South Seventh Blvd., St. Louis, Mo., awarded contract for the construction of a 2 story, 22 x 72 ft. addition to brass foundry to G. Moeller, 3520 Itaska, St. Louis, Mo. Estimated cost $25,000.

Brick Machinery, Etc.—Amarillo Clay Products Co., Box 246, 330 Amarillo Bldg., Amarillo, Tex., is receiving bids for dry pans, stiff mud brick machinery and repress for fire brick for proposed improvements to plant.

Brick and Tile Plant—Chattanooga Brick & Tile Co., Chattanooga, Tenn., plans improvements to brick and tile plant. Private plans. Machinery for the manufacture of rough texture face brick and tile will be required.

Candy Factory—National Candy Co., 208 North Broadway, St. Louis, Mo., will receive bids about Aug. 25 for the construction of a 5 story candy factory at Gravois and Bingham Sts. Estimated cost $1,000,000. Klipstein & Rathman, 316 North Eighth St., are architects.

Canning Plant—Gebbhardt Chilli Powder Co., 112 South Frio St., San Antonio, Tex., is having plans prepared for the construction of a 2 story, 70 x 100 ft. canning plant. Estimated cost $60,000. J. M. Marriott, Frost Bldg., San Antonio, Tex., is architect. Canning machinery for various classes of canned products consisting of Mexican dishes will be required.

Carbide and Carbon Plant—Union Carbide & Carbon Corp., 30 East 42nd St., New York, N. Y., plans the construction of a carbide and carbon plant at Duluth, Minn. Estimated cost $200,000.

Carbon Black Plant—W. B. Alt Engineering Co., Capps Bldg., Fort Worth, Tex., will soon receive bids for the construction of a carbon black plant. Estimated cost $150,000. Architect and engineer not selected.

Carbon Black Plant—Skelly Oil Co., Lubbock, Tex., plans the construction of a carbon black plant, 75,000 lbs. daily capacity. Estimated cost $300,000. Work will probably be done by Godfrey L. Cabot, Inc., Old South Bldg., Boston, Mass. Machinery and equipment will be required.

Carbon Black Plants—U. Carson & Associates, Laredo, Tex., is having preliminary plans prepared for the construction of carbon black plants one near Mirando City, Tex., for Cole oil fields; and one near Webb, Tex., for Carolina-Texas gas fields. Estimated cost $150,000 and $125,000 respectively. Private plans.

Carbonization Plant—International Combustion Engineering Corp., 200 Madison Ave., New York, N. Y., is having plans prepared for the construction of a low tension carbonization plant at Pescataway-town, N. J. Estimated cost to exceed $1,500,000. Private plans.

Cotton Compress—John Guiter, Colorado, Tex., plans the construction of a 60,000 bale capacity cotton compress. Work will probably be done by day labor and equipment purchased in open market. Estimated cost $125,000.

Cement Plant—Ashgrove Cement Co., Louisville, Neb., has work under way on the

construction of a cement plant. Estimated cost $2,000,000.

Cement Plant Addition—Missouri Portland Cement Co., 1010 Pine St., St. Louis, Mo., will receive bids about Sept. 1 for the construction of addition to cement plant including raw materials and clinker buildings, 80 x 160 ft. each, kiln building, 40 x 400 ft., quick hardening building, three batteries of silos and stack caisson with stack 220 ft. high and 22 ft. in diameter, etc. on Prospect Hill. Estimated cost $2,000,000. F. L. Smidth & Co., 50 Church St., New York, N. Y., are engineers.

Chemical Plant—G. W. Carnrick Co., 421 Canal St., New York, N. Y., plans the construction of a 2 story chemical plant at 2-24 Mt. Pleasant Ave., Newark, N. J. Estimated cost $40,000. Architect not selected.

Chemical Plant—Kuehne Chemical Co., Meadow Lane, Elizabeth, N. J., awarded contract for the construction of a 1 story, 70 x 85 ft. chemical plant to Parkinson Construction Co., 306 Monclair Ave., Newark, N. J. Estimated cost $40,000.

Chemical Plant—C. Lennig & Co., Richmond and Kennedy Sts., Philadelphia, Pa., awarded contract for the construction of a 2 story, 47 x 48 ft. chemical plant to Kempf & Kohlmeyer, 3543 Germantown Ave., Philadelphia, Pa. Estimated cost $15,000.

Chemical Plant—Richards Chemical Works, 190 Warren St., Jersey City, N. J., will soon award contract for the construction of a 2 story, 100 x 200 ft. chemical plant at Warren, Essex and Morris Sts. Estimated cost $100,000. E. M. Patterson, 76 Montgomery St., Jersey City, N. J.

Chemical Plant—Rumford Chemical Co., East Providence, R. I., awarded contract for the construction of a 1 story, 73 x 260 ft. and 5 story, 100 x 220 ft. chemical plant to The Aberthaw Co., 80 Federal St., Boston, Mass.

Chemical Plant & Warehouse—The E. L. Patch Co., 38 Mt. Vale Rd., Stoneham, Mass., manufacturing chemists, awarded contract for the construction of a 60 x 85 ft. chemical plant and warehouse to Somers & Drisco, Park Sq. Bldg., Boston, Mass.

Chlorine Machine—City of Guthrie, Okla., is in the market for a new liquid chlorine machine, for waterworks.

Chlorine Products Plant—Westvaco Chlorine Products, Inc., A. M. Pitcher, Gen. Mgr., South Charleston, W. Va., awarded contract for the construction of a chlorine products plant including sulphur recovery building, laboratory, etc., to H. K. Ferguson Co., 4900 Euclid Ave., Cleveland, O.

Clay Products Factory—Amarillo Clay Products Co., c/o H. Knopper, Pres., Amarillo, Tex., plans the construction of a clay products factory. Estimated cost $150,000.

Compressed Gas Plant—Linde Aire Products Co., 30 East 42nd St., New York, N. Y., plans the construction of a 1 story compressed gas plant at Tampa, Fla. Estimated cost $200,000. Work will be done by separate contracts.

Concentrating Plant—Atlantic & Pacific Products Co., H. M. Clark, Mgr., West Bend, Wis., awarded contract for the construction of a 2 story, 75 x 80 ft. concentrating plant at Winneconne, Wis., to Immel Construction Co., Sand Bldg., Fond du Lac, Wis. Estimated cost $40,000.

Condensing Plant, Etc.—Southern Gas Co., Frost Bldg., San Antonio, Tex., plans the construction of a natural gas condensing plant and distribution system at Seguin, Tex. Estimated cost $90,000. Private plans.

Cotton Oil Mill—Big Bend Cotton Oil Co., c/c J. M. Duke, Marfa, Tex., has acquired a site and plans the construction of a cotton oil mill. Estimated cost $75,000. Private plans. Machinery and equipment will be required.

Creamery—The Dairymen's Co-operative Association, c/o L. C. Laney, 104 East Josephine St., San Antonio, Tex., has purchased site on Josephine St., and plans the construction of a creamery to have a capacity of 1,000 gal. raw and pasteurized milk per hour. Estimated cost $200,000.

Drug Manufacturing Building—Owner, c/o C. A. Dean, 506 Reliance Bldg., Kansas City, Mo., Archt., will soon award contract for the construction of a 1 and 2 story, 35 x 136 and 50 x 136 ft. drug manufacturing building.

Gasoline Extraction Plant—National Gas Products Co., Shreveport, La., is having plans prepared for the construction of a gasoline extraction plant. Estimated cost including equipment $150,000. Private plans.

Glass Plant—Standard Plate Glass Co., First National Bank Bldg., Pittsburgh, Pa., is having plans prepared for the construction of a 4 story, 40 x 153 ft. glass plant. Estimated cost $150,000. Hunting, Davis & Dunnells, Century Bldg., Pittsburgh, Pa., are architects.

Gypsum Plant—U. S. Gypsum Co., 300 West Adams Ave., Chicago, Ill., awarded contract for the construction of a 1 story, 60 x 200 ft. gypsum plant at 58th and Schuylkill Rd., to Metzger Fisher & White, Otis Bldg., Philadelphia, Pa.

Kraft Mill—National Paper Products Co., 1789 Montgomery St., San Francisco, Calif., is having plans prepared for the construction of a 180 x 850 ft. kraft mill including chemical plant, screening and beater buildings, etc. at Port Townsend, Wash. Estimated cost $2,000,000 to $3,000,000. V. D. Simons, 431 North Michigan Ave., Chicago, Ill., is engineer.

Laboratory—Panhandle A. & M. College, Goodwell, Okla., awarded contract for the construction of a 3 story laboratory to Baily & Burns, Norman, Okla. Estimated cost $150,000.

Laboratory—St. Thomas Seminary, M. F. McAuliffe, West Hartford, Conn., had plans prepared for the construction of a hospital including laboratory, on Bloomfield Rd. Estimated cost $1,000,000. L. A. Walsh, 51 Leavenworth St., Waterbury, is architect.

Manganese Drying Pump—B. H. Cawthon, 406 Edwards Hotel Bldg., Jackson, Miss., is in the market for a 10 or 12 in. manganese drying pump.

Oil Cloth Factory—Chandler Oil Cloth Co., 103 Old Colony Ave., East Taunton, Mass., awarded contract for the construction of a 1 story, 100 x 165 ft. addition to oil cloth factory at Taunton, Mass. to Morton C. Tuttle Co., Park Sq. Bldg., Boston, Mass.

Oil Mill—Lockhart Oil Mill, c/o M. D. Dey, Lockhart, Tex., plans to rebuild portion of oil mill recently destroyed by fire. Estimated cost $45,000. Machinery and equipment including cookers, crushers, etc. will be required.

Oil Refinery—Humble Oil & Refining Co., Houston, Tex., has acquired a 200 acre site and plans the construction of an oil refinery, etc. near Ingleside, Tex. Estimated total cost $900,000. Private plans.

Oil Refinery—J. Kegan, Plain View, Tex. and T. Thornton, Amarillo, Tex., are having preliminary plans prepared for the construction of an oil refinery at Hale Center, Tex. Estimated cost $125,000. Private plans.

Olive Products Plant—Proctor & Gamble Co., Port Ivory, Staten Island, N. Y., awarded contract for the construction of a 4 story, 32 x 96 ft. olive products plant to H. K. Ferguson Co., 4900 Euclid Ave., Cleveland, O. Estimated cost $50,000.

Paint Factory—Dean & Barry Co., 296 North Water St., Columbus, O., is having plans prepared for the construction of a 4 story, 50 x 100 ft. paint factory. Estimated cost $61,000. C. Hibbs, Worthington, O., is architect.

Paint Factory—J. C. James, 2300 87th Ave., Oakland, Calif., is having plans prepared for the construction of a 1 story paint factory at 88th Ave. and B St. Estimated cost $40,000. Woolworth Paint Co., c/o owner, lessee.

Paper Mill—American Reinforced Paper Co., 45 County St., Attleboro, Mass., is having preliminary plans prepared for the construction of a paper mill on Starkey St. Estimated cost $40,000. C. T. Main, 201 Devonshire St., Boston, Mass., is architect.

Paper Plant—The Chillicothe Paper Co., E. F. Bearce, V. Pres., Chillicothe, O., awarded contract for the construction of a 2 story, 40 x 541 ft. paper plant to H. K. Ferguson Co., 4900 Euclid Ave., Cleveland, O. Estimated cost $100,000.

Paper Plant—Spencer-Wynne Paper Co., Newburgh, N. Y., awarded contract for the construction of a 1 story, 120 x 340 ft. paper plant to H. K. Ferguson Co., 4900 Euclid Ave., Cleveland, O. Estimated cost $100,000.

Paper Products Plant Addition—National Paper Products Co., Stockton, Calif., awarded contract for the construction of a 2 story paper products plant to Barrett & Hiln, 918 Harrison St., San Francisco, Calif. Estimated cost $100,000.

Plant—Presto-O-Lite Co., 30 East 42nd St., New York, N. Y., has acquired a site and plans the construction of two buildings, 2 and 3 story for industrial plant at Dallas, Tex. Estimated cost $200,000.

Pottery—Crooksville China Co., Crooksville, O., will soon award contract for the construction of a 1 story, 30 x 100 ft. pottery. Estimated cost $40,000.

Pottery—Weller Pottery Co., Zanesville, O., plans to rebuild 3 or 4 story pottery to replace fire loss. Estimated cost $400,000. Private plans. Machinery and equipment will be required.

Pulp and Paper Mill—Canadian Forest Products Ltd., Vancouver Island, B. C., plans the construction of a pulp and paper mill, also a power development on the Nimpkish River at Beaver Cove, B. C. Estimated cost approximately $12,000,000.

Pulp and Paper Mill—The Kelso Paper Co., Kelso, Wash., P. J. Gallagher, Bedell Bldg., Portland, Ore., recently incorporated for $200,000, plans the construction of a pulp and paper mill.

Pulp and Paper Plant—E. Knight, Kelso, Wash., is having preliminary plans prepared for the construction of a pulp and paper plant. Estimated cost $150,000.

Pulp and Paper Mill—The Quebec Pulp & Paper Co., Ltd., Chicoutimi, Que., plans the construction of a pulp and paper mill 250 ton daily capacity.

Rayon Mill—Dupont Rayon Co., Wilmington, Del., plans addition to unit No. 2 and constructing a third unit to rayon plant at Old Hickory, Tenn. Estimated cost $4,000,000. Private plans.

Rubber Factory—Firestone Rubber Co., South Main St., Akron, O., has acquired a site and plans the construction of a rubber factory at Los Angeles, Calif. Estimated cost $1,000,000.

Rubber Factory—Firestone Tire & Rubber Co., Beach Rd., Hamilton, Ont., is having plans prepared for the construction of addition to rubber factory. Estimated cost $60,000. C. A. Meyers, c/o owner, is engineer.

Rubber Factory—The General Tire & Rubber Co., 1708 East Market St., Akron, O., awarded contract for the construction of three factory buildings, 1 and 4 story each to Clemmer & Johnson, 470 East Market St., Akron, O. Estimated cost $250,000.

Rubber Plant Addition—Lancaster Tire & Rubber Co., Gugle Bldg., Columbus, O., is having sketches made for the construction of a 1 story, 50 x 75 ft. addition to rubber plant at Lancaster, O. Estimated cost $50,000. Private plans.

Silk (Artificial) Plant—Furness Corp., W. H. Furness, Pres., National Park, N. J., c/o West Jersey Guarantee & Title Co., 304 Camden, N. J., plans the construction of an artificial silk plant at Camden, N. J. Estimated cost $10,000,000. Architect not selected.

Skimming Plant—E. C. Hofstra, Amarillo, Tex., is having preliminary plans prepared for the construction of a skimming plant near Plainview, Tex. Estimated cost $75,000. Private plans.

Soap Factory—Scholler Bros. Inc., Amber and Westmoreland Sts., Philadelphia, Pa., plans the construction of a soap factory at St. Catherines, Ont. Estimated cost $175,000. Machinery and equipment for the manufacture of soaps, softeners, sulphenated oils and finishing compounds for all textiles will be required.

Starch Mill—Huron Milling Co., Harbor Beach, Mich., is having plans prepared for the construction of a 3 story, 100 x 220 ft. starch mill. Estimated cost $180,000. Private plans.

Stove Factory—Eco-Thermal Stove Co., S. S. Thomas, Pres., Lebanon, O., is having plans prepared for the construction of a stove factory at Cincinnati Pike. Estimated cost $40,000. Private plans.

Sugar Factory—Penick & Ford, Cedar Rapids, Ia., awarded contract for the construction of a 2 story, 100 x 163 ft. sugar factory to Lightner Bros., 94 Second Ave. W., Cedar Rapids, Ia. Estimated cost $68,000.

Tannery—Badger State Tanning Co., South Water St. and Maryland Ave., Sheboygan, Wis., awarded contract for the construction of a 2 story, 85 x 117 ft. tannery to W. Guenther & Sons, 1224 North Fourth St. Estimated cost $40,000.

Tannery—C. S. Hyman Tannery Co., F. D. Jarvis, Gen. Mgr., London, Ont., plans to rebuild 1 story, tannery to replace fire loss. Estimated cost $250,000. Private plans. Equipment for manufacturing and drying leather will be required.

Tile Making Machine, Etc.—General Clay Products Co., Huntington National Bank Bldg., Columbus, O., is in the market for one large size combination tile making machine, one sewer pipe press, and other equipment for proposed 2 story, 40 x 100 ft. factory at Baltic, O. Estimated cost $50,000.

Yeast Factory—Fleischmann Co., 2655 West 19th St., Chicago, Ill., awarded contract for masonry, etc. for a 3 story, 66 x 125 ft. factory at 4801-4825 South Oakley Ave. Estimated cost $200,000.